

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p> <p>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>					
1. REPORT DATE (DD-MM-YYYY) 22 May 2012		2. REPORT TYPE Master's Thesis		3. DATES COVERED (From - To) 25 July 2011 - 15 June 2012	
4. TITLE AND SUBTITLE Command and Control in a Complex World				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
				5d. PROJECT NUMBER	
6. AUTHOR(S) Lieutenant Colonel David V. Gillum, USA				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Joint Forces Staff College Joint Advanced Warfighting School 7800 Hampton BLVD. Norfolk, VA 23511-1702				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The national security problems facing the Joint Force are increasingly ill-defined and can be characterized as "wicked problems" and that these "wicked problems" cannot be solved solely by better planning or decision support processes. The current joint definition of command and control does not adequately address changes introduced through technology trends, our understanding of the global operating environment, and capabilities offered by modern information and communications technology. The inclusion of mission command in joint doctrine as a method to synchronize the actions of tactical elements of the Joint Force is necessary if the Joint Force is to work effectively within the 21st century operational environment. A joint version of the current Army and Marine Corps concept of mission command could provide a more agile and adaptable force - a force capable of achieving unity of effort within the framework of "whole of government" approaches to challenges in the operational environment today and well into the future.					
15. SUBJECT TERMS Command and Control, Wicked Problems, Power to the Edge, Mission Command					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Unclassified Unlimited	18. NUMBER OF PAGES 81	19a. NAME OF RESPONSIBLE PERSON
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (Include area code) 757-443-6301

INSTRUCTIONS FOR COMPLETING SF 298

1. REPORT DATE. Full publication date, including day, month, if available. Must cite at least the year and be Year 2000 compliant, e.g. 30-06-1998; xx-06-1998; xx-xx-1998.

2. REPORT TYPE. State the type of report, such as final, technical, interim, memorandum, master's thesis, progress, quarterly, research, special, group study, etc.

3. DATES COVERED. Indicate the time during which the work was performed and the report was written, e.g., Jun 1997 - Jun 1998; 1-10 Jun 1996; May - Nov 1998; Nov 1998.

4. TITLE. Enter title and subtitle with volume number and part number, if applicable. On classified documents, enter the title classification in parentheses.

5a. CONTRACT NUMBER. Enter all contract numbers as they appear in the report, e.g. F33615-86-C-5169.

5b. GRANT NUMBER. Enter all grant numbers as they appear in the report, e.g. AFOSR-82-1234.

5c. PROGRAM ELEMENT NUMBER. Enter all program element numbers as they appear in the report, e.g. 61101A.

5d. PROJECT NUMBER. Enter all project numbers as they appear in the report, e.g. 1F665702D1257; ILIR.

5e. TASK NUMBER. Enter all task numbers as they appear in the report, e.g. 05; RF0330201; T4112.

5f. WORK UNIT NUMBER. Enter all work unit numbers as they appear in the report, e.g. 001; AFAPL30480105.

6. AUTHOR(S). Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES). Self-explanatory.

8. PERFORMING ORGANIZATION REPORT NUMBER. Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES). Enter the name and address of the organization(s) financially responsible for and monitoring the work.

10. SPONSOR/MONITOR'S ACRONYM(S). Enter, if available, e.g. BRL, ARDEC, NADC.

11. SPONSOR/MONITOR'S REPORT NUMBER(S). Enter report number as assigned by the sponsoring/monitoring agency, if available, e.g. BRL-TR-829; -215.

12. DISTRIBUTION/AVAILABILITY STATEMENT. Use agency-mandated availability statements to indicate the public availability or distribution limitations of the report. If additional limitations/ restrictions or special markings are indicated, follow agency authorization procedures, e.g. RD/FRD, PROPIN, ITAR, etc. Include copyright information.

13. SUPPLEMENTARY NOTES. Enter information not included elsewhere such as: prepared in cooperation with; translation of; report supersedes; old edition number, etc.

14. ABSTRACT. A brief (approximately 200 words) factual summary of the most significant information.

15. SUBJECT TERMS. Key words or phrases identifying major concepts in the report.

16. SECURITY CLASSIFICATION. Enter security classification in accordance with security classification regulations, e.g. U, C, S, etc. If this form contains classified information, stamp classification level on the top and bottom of this page.

17. LIMITATION OF ABSTRACT. This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.

NATIONAL DEFENSE UNIVERSITY
JOINT FORCES STAFF COLLEGE
JOINT ADVANCED WARFIGHTING SCHOOL



COMMAND AND CONTROL IN A COMPLEX WORLD

by

David V. Gillum

Lieutenant Colonel, United States Army

This Page Intentionally Left Blank

Command and Control in a Complex World

by

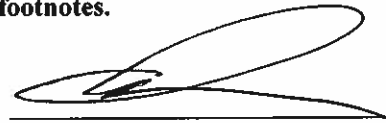
David V. Gillum

Lieutenant Colonel, United States Army

A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

Signature: _____



22 May 2012

Thesis Adviser:

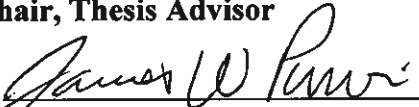
Signature: _____



Mr. Benjamin F. Wible, National Security Agency Chair, Thesis Advisor

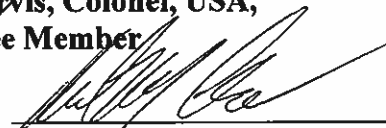
Approved by:

Signature: _____



**James Purvis, Colonel, USA,
Committee Member**

Signature: _____



Robert Antis, Ph.D., Committee Member

Signature: _____



**James Miller, Colonel, USMC, Director,
Joint Advanced Warfighting School**

This Page Intentionally Left Blank

ABSTRACT

The U.S. Joint Force stands alone in its ability to conduct large scale combined arms warfare. Our unquestioned dominance leaves potential adversaries with no choice but to learn and adapt. This “messy intersection” between the industrial age and the information age is the groundswell of the evolutionary process; military adaptation. The national security problems facing the Joint Force are increasingly ill-defined and can be characterized as “wicked problems” and that these “wicked problems” cannot be solved solely by better planning or decision support processes. The current joint definition of command and control does not adequately address changes introduced through technology trends, our understanding of the global operating environment, and capabilities offered by modern information and communications technology. The inclusion of mission command in joint doctrine as a method to synchronize the actions of tactical elements of the Joint Force is necessary if the Joint Force is to work effectively within the 21st century operational environment. A joint version of the current Army and Marine Corps concept of mission command could provide a more agile and adaptable force - a force capable of achieving unity of effort within the framework of “whole of government” approaches to challenges in the operational environment today and well into the future.

DEDICATION

First and foremost, Dr. Debbie, Austin and Erin. They put up with the rest of a fourth year and most of a fifth with me living away from home. Their resilience, support, and general all-around goodness made this year possible as I undertook the single most difficult endeavor of my life.

To Sem II. You gents made learning fun. Thank you for everything, particularly the opportunity to discuss C2 arrangements at Anzio. Couldn't have done this without your brutal, yet entertaining, commentary. Well played...

Finally, to the junior officers and senior NCOs I hope read this. If we will have change, it will come from you. Stay proud, Stay Airborne.

ACKNOWLEDGEMENTS

“Doc” Ben Wible assisted greatly in organizing this thesis and ensuring logical flow and an identifiable river of thought

Dawn Joines and Catrina Whited, reference librarians at the Ike Skelton Library, were instrumental in ensuring sources were properly cited. Their input was absolutely necessary and deeply appreciated.

Brent Ruhlen taught me how to format macros, making the whole formatting and publication preparation processes significantly easier.

Dr. Dotolo provided an eagle eye as proofreader. His contributions ensured compliance with the rules of English grammar. Any remaining errors are my own.

This Page Intentionally Left Blank

TABLE OF CONTENTS

ABSTRACT.....	i
DEDICATION.....	ii
ACKNOWLEDGEMENTS.....	iii
INTRODUCTION	1
Background	5
The Requirement for Agile, Adaptive Processes	6
CHAPTER 1: WICKED PROBLEMS - FROM NEWTON TO THE EDGE	11
The Battle of Trafalgar.....	22
The Battle of Stalingrad	24
CHAPTER 2: COMMAND AND CONTROL - WORDS HAVE MEANING.....	30
CHAPTER 3: COMMAND AND CONTROL IN DOCTRINE	42
Joint Doctrine	42
Service Doctrine.....	44
United States Army	45
United States Marine Corps.....	46
United States Navy	49
United States Air Force	50
CHAPTER 4: MISSION COMMAND	52
Millennium Challenge 2002.....	59
CONCLUSION.....	63
BIBLIOGRAPHY.....	66
VITA.....	71

This Page Intentionally Left Blank

INTRODUCTION

“We live between two great chapters of human history, in the messy interspaces of the industrial age we are leaving and the Information Age we are entering. What the United States does and does not do, to and with its military, will define the character of military competition and the content of international relations for decades to come.”

-- Vice Admiral Arthur Cebrowski, USN (Ret.)

“Global Trends 2025: A Transformed World” published in November 2008 states that the next two decades will consist of multiple, global factors, each impacting on how nations interact, and how our national and military leadership responds. The document succinctly describes the true essence of complexity - “no outcome seems preordained.”¹ This underlying truth has enormous impact on the Joint Force and how the Joint Force responds to safeguarding our national interests.

In late 2001, while serving as the Director, Office of Transformation under Secretary of Defense Donald Rumsfeld, Vice Admiral (VADM) Art Cebrowski stated that technology leads to evolutionary change. Further, VADM Cebrowski believed these changes should be viewed as the lever to increase the U.S. military’s lethality via effective operations within this new domain, this new age of information and the networks that powered it. “We would be wrong to let our current military dominance lull us into arrogance or lethargy... We should choose to transform what is today the world’s most powerful military... We should push—more rapidly, strongly, and diligently than we have—the potential capabilities that technology opens into the way we organize, structure, train, and use the U.S. military.”²

¹ National Intelligence Council. *Global Trends 2025: A Transformed World*. Government Printing Office (Washington, DC, November 2008): 3.

² Vice Admiral Arthur Cebrowski as quoted by James Blaker, “Arthur K. Cebrowski: A Retrospective,” *Naval War College Review*, Vol. 59, No. 2 (Spring 2006): 130.

The U.S. Joint Force stands alone in its ability to conduct large scale combined arms warfare. Our unquestioned dominance leaves potential adversaries with no choice but to learn and adapt. This “messy intersection” between the industrial age and the information age is the groundswell of the evolutionary process of military adaptation. We must ask ourselves how we will leverage new technologies and the increasing availability of information for the Joint Forces of today and tomorrow. The United States does an exceptional job applying new and emerging technologies to weapons systems and their employment in today’s global environment.³ What about tomorrow? Is the Joint Force prepared to incorporate emerging technologies and the unique capabilities they provide to modern warfare into our command and control doctrine and systems?

This thesis argues that the inclusion of mission command in joint doctrine, as a method to synchronize the actions of tactical elements of the Joint Force, is necessary if the Joint Force is to work effectively within the 21st century operational environment. A joint version of the current Army and Marine Corps concept of mission command could provide a more agile and adaptable force - a force capable of achieving unity of effort within the framework of “whole of government” approaches to challenges in the operational environment today and well into the future.

This thesis statement rests upon two foundational pillars. The first pillar is that the national security problems facing the Joint Force are increasingly ill-defined and can be characterized as “wicked problems”⁴ and that these “wicked problems” cannot be

³ Joint Chiefs of Staff, *Joint Vision 2010*, (Washington DC, 1995):11-13

⁴ Wicked problems are those where the problem to be solved is not completely defined, and after action is taken to address the problem, it is not clear if the problem is actually solved. There are no definitive, objective solutions to wicked problems. For a complete definition of wicked problems, see Horst W.J.

solved or resolved solely by better planning or decision support processes. The second argument is that the current joint definition of command and control does not adequately address changes introduced through technology trends, our understanding of the global operating environment, and capabilities offered by modern information and communications technology. This thesis does not call for the replacement of joint planning doctrine, nor does it advocate scrapping current doctrine relating to the concept of command. It recognizes the absolute value of joint planning and reinforces the primacy of the commander and the command function. Finally, it does not argue for any approach that would relieve commanders of responsibility for the actions of his or her subordinates.

The thesis is laid out in an introduction, followed by four chapters. The introduction contains background information intended to bound the discussion and provides essential information and exposition. It includes a brief discussion of the global environment as we understand it, definitions of key terms that explain the type and complexity of problems facing the Joint Force, and the broad trends that shape our current and future environments. This background discussion includes the broad trends and forces shaping the world, including democratization of information, and the resulting requirement for increasingly agile and adaptive processes to respond effectively to challenges.

The first chapter defines wicked problems and argues that these types of problem are those that face the Joint Force going forward. It is a discussion of an industrial-age, Newtonian, linear understanding of the world contrasted to our emerging understanding

Rittel and Melvin M. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973) 155-169.

of complex, post-Newtonian, non-linear world. “Wicked problems” and “power to the Edge” concepts are introduced, and further developed through focus on limitations of current planning doctrine. The intellectual foundation is drawn from Rittel and Webber’s work in problems inherent in any generalized planning theory, first published in 1973. This chapter concludes with a discussion of our current processes’ requirement for anticipatory and predictive output, vice our requirement for agile and adaptive output.

The second chapter addresses the second argument, namely that a deficiency in joint command and control doctrine is antithetical to training and employing a Joint Force capable of the agile, adaptable approach required to meet threats to our national security. It describes current command and control doctrine with some recommendations on ways to adapt to a world that demands increasing awareness of interactions and networks, both informational and social. The concepts introduced in this chapter rely on Alberts and Hayes’ “Power to the Edge” for their theoretical and academic framework.

The third chapter is a discussion of existing joint command and control doctrine and includes individual service doctrine and how they differ. The chapter highlights differences between the services and how those differences can impact the Joint Force understanding of command and control. The intent is to ensure the reader understands key terms, both in a Joint Force context, and from an individual service perspective.

The fourth chapter makes a specific joint doctrinal recommendation to address this deficiency. The concept of mission command, already a part of both Army and Marine Corps doctrine, has enormous potential to exploit modern information and communications technology and must be incorporated into joint doctrine. Mission command has the potential to combine the art and science of command and control in an

information age, connected, complex world. Mission command replaces command and control. The control function in this context is provided by feedback - the continuous flow of information about the environment, and the changed situation based on subordinate initiative returning to the commander which allows the commander to adjust and modify command action as needed. Importantly, "control is not strictly something which seniors impose on subordinates; rather, the entire system gains control . . . based on feedback about the changing situation... to ensure that the force as a whole can adapt continuously to changing requirements."⁵

Background

Any understanding of the future global environment requires taking notice of the broad trends affecting the world today. The National Intelligence Council's publication *Global Trends 2025* identifies seven areas in which current trends could produce alternative futures for the international community in general and their potential impacts on the United States. The report acknowledges that the potential outcomes are not inevitable, nor are they necessarily likely. The report also notes three overarching lessons from the previous century. Those lessons are that leaders and their ideas matter, that the global economy and its volatility introduces significant risk, and that geopolitical rivalry and its consequences are responsible for significantly more wars, and rise and fall of powers, than technological change.⁶ These three lessons remain relevant and must be considered as the Joint Force strives to understand the current environment as well as the future global environment.

⁵ Department of Defense, United States Marine Corps, "*Marine Corps Concept Paper 6: Command and Control*" (draft) (Headquarters, USMC, Washington, DC, 12 December 1995): 43-46.

⁶ National Intelligence Council, *Global Trends 2025*, 3-5.

The alternative futures envisioned in *Global Trends 2025* are built around current operating environment trends which include an increasingly connected global economy, competition for resources, changes in relative power between Nations, the rise of non-state actors, and capability and capacity of the existing International System among other potential strategic challenges. Each of the challenges identified supports different alternative futures. Each alternative future is influenced by the success or failure of United States actions to address the underlying strategic challenges. Against this background, it is imperative that the Department of Defense and the Joint Force adapt to defend effectively the United States' National interests. The interaction between nation-states, non-state actors, and transnational organizations cannot be discounted. The Joint Force response to threats to the National interest is constrained by our ability to resource the force, itself a challenge in the midst of a global economic downturn.

The Requirement for Agile, Adaptive Processes

In a world of joint and coalition military operations, closely coupled with a whole of government approach to warfighting, it is apparent that our traditional ways of thinking about and executing the joint command and control function are no longer adequate. As we rethink command and control, we are also exploiting new information and communication technologies and capabilities. These capabilities present opportunities to achieve the goals of command and control systems in ways we never could before. The result is a “perfect storm” between the requirement for a change in how we conceptualize and apply command and control (the need to change) with the enabling technology that will allow us to do so (the means to change). The opportunity to make the change from an industrial age construct of command and control to an

information age construct is here. If we fail to take advantage of this opportunity, our insistence on retaining a sub-optimal command and control structure will place us at a strategic disadvantage against an adaptive adversary who adopts a command and control construct and attendant systems designed to exploit the opportunities afforded by modern information and communication technologies.⁷

Although the U.S. Joint Force has been through multiple restructurings since its inception in 1947, the services themselves have not made major revisions to their basic organizational models in over 100 years.⁸ As the global strategic environment grows increasingly complex, and “Wicked Problem” sets proliferate, the Joint Force response has been essentially to digitize existing command and control processes. Our increasing awareness of the world’s complexity and the increasing speed at which that world changes leads to increasingly complex command and control systems without a corresponding increase in effectiveness as measured by unequivocal victory. In the 21st century, there is an explicit understanding that the problems the Joint Force faces are increasingly complex, “wicked problems” that do not lend themselves to a single, correct solution. These unstructured, difficult to define problem sets require agile and flexible responses.

Not surprisingly, most of the literature behind our current understanding of command and control focuses on the science. Net-centric Warfare, Effects Based Operations, and System of Systems analyses all attempted to improve our military’s ability to predict problems or the actions of potential adversaries and to ensure the Joint

⁷ David S. Alberts and Richard E. Hayes, *Understanding Command and Control* (Washington, DC: Department of Defense Command and Control Research Program, 2006), vii.

⁸ Major-General M.K. Jeffery, “Forward,” in *The Human in Command: Exploring the Modern Military Experience, Proceedings of a NATO RTO workshop held in Kingston, Jamaica 8-12 June 1998*, ed. Caroline McCann and Ross Pigeau, v-vii (New York, Kluwer Academic/Plenum Publishers), vi.

Force is postured to respond and to gain the initiative – to get inside the adversaries decision cycle using a perceived technological advantage. Comparatively little critical thought has gone into the human element of command and control. The result is increasing reliance on a technological solution to the fog and friction of war.⁹ This reliance on a technological solution to our current problems conceptualizing command and control in a digital world fails to take into account the fundamentally social nature of war.

Clausewitz identified the social nature of war as “...a paradoxical trinity – composed of primordial violence, hatred and enmity, which are to be regarded as a blind natural force; of the play of chance and probability within which the creative spirit is free to roam; and of its element of subordination, as an instrument of policy, which makes it subject to reason alone.”¹⁰ The second leg of the trinity, the play of chance and probability, “concerns... the commander and his army... The scope which the courage and talent will enjoy in the realm of probability and chance depends on the particular commander and the army.”¹¹ This insight, the importance of the commander as the human element in all extant command and control models, is critical to any successful transition of the Joint Force command and control construct to integrate capabilities inherent in the information age and to account for an increasingly connected and complex world. Any command and control construct going forward that ignores or subordinates the human element of command and control “... would conflict with reality to such an

⁹ Lieutenant General William S. Wallace, “Network-Enabled Battle Command,” *Military Review* (May/Jun 2005): 2-3.

¹⁰ Carl von Clausewitz, *On War*, trans. and ed. by Michael Howard and Peter Paret (New York, Toronto: Alfred A. Knopf, 1993), 101.

¹¹ *Ibid.*, 101.

extent that for this reason alone it would be totally useless.”¹² Simply stated, any command and control discussion or doctrine that does not recognize the human element does not accurately model the world as it exists.

Management tools and processes used to control major programmatic decisions do not translate well to the operational environment. In both instances personalities matter, but the operational force is confronted daily with a requirement to make and execute decisions significantly more constrained by time – the difference, for instance, between the “Washington Clock” and the clock in Afghanistan or Iraq. Further, strategic decisions have tactical implications and any command and control model applied at the operational level of war must account for those implications and provide guidance and resources to link the strategic and tactical fights.

Moving forward, as we balance the human and technological aspects of command and control, there are a number of questions we must answer. Chief among these are those specific to the human element. How much information can the commander and staff actually process and understand? Should we make efforts to adapt the technology to the people or should we expect people to adapt to technology? We claim that people are the most important part of our systems yet our systems are not designed to optimize the performance of our people. What are the human limits to command? Command is social and depends on personal relationships and the maintenance of trust between people. How does technology affect those relationships?¹³

The answers to these questions impact the effectiveness of the Joint Force. Against the global environment, and the potential for a wide range of potential futures,

¹² Clausewitz, *On War*, 101.

¹³ Jeffery, “Forward,” in *The Human in Command*, vi-vii.

our ability to safeguard National interests depends on the ability of the Joint Force to adapt to the world as it exists. Both our ability to adapt, and the agility with which we adapt are dependent on human beings with the cognitive elasticity to recognize changes in the environment and react appropriately. It is this human element, the “human in command,” that offers the greatest promise for the Joint Force. In a world which cannot be predicted, the human in command must identify and exploit the opportunities inherent in all volatile, uncertain situations and environments.

CHAPTER 1: WICKED PROBLEMS - FROM NEWTON TO THE EDGE

“The professionalized cognitive and occupational styles that were refined in the first half of this century, based in Newtonian mechanistic physics, are not readily adapted to contemporary conceptions of interacting open systems and to contemporary concerns with equity. A growing sensitivity to the waves of repercussions that ripple through such systemic networks and to the value consequences of those repercussions has generated the recent reexamination of received values and the recent search for national goals.”

-- Horst Rittel, *Dilemmas in a General Theory of Planning*

Since the publication of the *Principia Mathematica*,¹ human understanding of the world has been a linear one, predicated on causal relationships which were explained through science and proven through the scientific method. Outcomes could be predicted to a certainty. This approach to the world and to problem solving was well-suited to the industrial age, reaching its apotheosis mid-20th century. Management theory was believed to be absolutely necessary if an organization was to be effective and efficient. Good theories linked causes to effects to produce predictive models which tended to produce dramatic improvements in product outputs relative to resource inputs and led to precisely calibrated performance measures. Management theory was concerned primarily with achieving efficiency, producing the greatest output with the least investment of resources.² This approach relied on a mechanistic world view, characterized by 18th century physics. It was a Newtonian world. Processes and systems developed in response to Newtonian physics solved the problems of the industrial age. Railroads

¹ Newton's *Philosophiae Naturalis Principia Mathematica* (Mathematical Principles of Natural Philosophy), first published in 1686, explained planetary motion using laws of motion derived and demonstrated on earth. His work linked terrestrial and celestial theories of motion and accurately described the motion of both earthbound objects and celestial bodies. The work was transformative and was a major force in the maturity of natural philosophy into our modern understanding of science. For additional information, see William L. Harper, *Isaac Newton's Scientific Method: Turning Data into Evidence about Gravity and Cosmology* (Oxford, Oxford University Press, 2011).

² Gordon Pearson, *The Rise and Fall of Management: A Brief History of Practice, Theory and Context*, (Farnham, Surrey: Gower Publishing, Ltd., 2009), 123-124.

crossed continents, factories produced ever increasing quality and quantities of goods, arable land produced greater and greater amounts of foodstuffs; and engineering marvels dammed rivers, providing reliable water sources to settlements in areas previously uninhabitable, and generating power to keep the lights on. Each of these successes solved a well-defined, well-bounded problem.

By the late 1960s, governments increasingly turned to solving social problems. The civil rights movement, the war on poverty, and the war on drugs are all examples of social issues and government action to address them. Unlike electrifying rural America or building an interstate highway system, these issues were not linear and could not be solved through pure application of science and scientific method. By 1973, Horace Rittel and Melvin Webber recognized these social problems as a different class and named them “wicked problems.” They are characterized by the following postulates:

1. There is no definitive formulation of a wicked problem
2. Wicked problems have no stopping rule
3. Solutions to wicked problems are not true-or-false, but good-or-bad
4. There is no immediate and no ultimate test of a solution to a wicked problem
5. Every solution to a wicked problem is a "one-shot operation"
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan
7. Every wicked problem is essentially unique
8. Every wicked problem can be considered to be a symptom of another problem

9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways

10. The planner has no right to be wrong³

There is no definitive formulation of a wicked problem. Wicked problems are not amenable to a single definition of the problem. There are a number of ways to define any complex problem, and the very act of defining it will drive planners to a solution set that only addresses the problem as defined. In joint doctrine, this will lead inevitably to actions designed solely to solve the problem as defined, not necessarily the problem as it exists.

Wicked problems have no stopping rule, so there is no end state in wicked problems. Any solution or solution set will not address all relevant variables. The result is problem resolution, vice problem solution, and tension from those unaddressed variables acting on the problem will continue until point of crisis. This inherent characteristic of wicked problems ensures any planned solution will not be permanent. The problem will need to be resolved repeatedly over time as long as it remains a National interest.

There is no single, correct solution to a wicked problem. Any solution must be judged relative to the resolution of the problem and the resources expended to achieve resolution. Further, the means used to achieve resolution also bear on the relative merit of the planning solution.

Prior to execution, there is no possible way to test the proposed solution. Effectively, any proposed solution is an exercise in hope. While the logic chain leading to a proposed solution can be examined, the description of the environment and the

³ Rittel and Webber, "Dilemmas in a General Theory," 161-166.

expression of the planning problem cannot be informed by every variable operating on the problem. The result is a proposed solution that cannot be tested prior to execution. The result is often unintended consequences, some of which are worse than the original planning problem.

Because there is no opportunity to learn by trial-and-error, every attempt counts significantly. Derived from the fourth and seventh postulates, any solution chosen because of a perceived similarity to a previous problem may well fail.⁴ Since each problem is unique, each solution must also be unique. Lessons derived in hindsight may not apply to a new wicked problem as the unknown, interdependent variables may well be different in different problems, and those variables that are the same do not necessarily interact in the same way. Essentially, any attempt to solve a problem stands alone. If it fails, tweaking the proposed solution is unlikely to work. A new, unique solution must be developed and executed.

There are no criteria that prove planners have identified all possible solutions to a given problem. Once the problem is defined (a process which by definition eliminates other potential ways of understanding, then resolving the problem), planners develop any number of potential solutions. There will be another set of potential solutions which will never even be considered. In a wicked problem where there is no such thing as a right or wrong solution, potentially effective solutions will never be considered and the planner will never be able to establish how many potential solutions he never considered.⁵

Unlike mathematical problems, there is no way to prove a potential solution to a wicked problem will work. Any solution must be chosen through judgment.

⁴ Those postulates state that there is no immediate and no ultimate test of a solution to a wicked problem and every wicked problem is essentially unique.

⁵ Rittel and Webber, "Dilemmas in a General Theory," 164.

Every wicked problem is essentially unique. While the expression of the problem may look eerily similar to problems seen before, the causes most assuredly differ. Not only do they differ, there is no way to tell going in exactly how the causes differ from previous problems. The result of attempting to solve a new wicked problem by a technique used successfully on a seemingly similar previous problem will almost universally be unintended consequences at best, resolution failure at worst. This principle is perhaps best illustrated in commentary from Colonel John E. O'Neil, former commander of the 82d Sustainment Brigade. At a commanders' conference in the spring of 2010, COL O'Neil remarked that in his first 90 days in Afghanistan he walked into a problem set he recognized from a previous deployment on six separate occasions. All six times he said he knew the solution immediately. He closed by pointing out he was wrong all six times.⁶

Every wicked problem can be considered to be a symptom of another problem. Related to the first postulate, this means that however the problem is defined it may be expressed as a result of another, related problem.⁷ When formulating a problem statement to a planning problem, the accepted problem statement can always be expressed as a symptom of another, completely different problem statement that also describes the planning problem. It is this characteristic that often results in planners solving the "wrong problem."

The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's

⁶ Colonel John E. O'Neil, "Commander's Comments" (speech, 135th Expeditionary Sustainment Command headquarters, Kandahar Air Base, Afghanistan, March 2010).

⁷ The first postulate states there is no definitive formulation of a wicked problem.

resolution. Once planners describe a given planning problem, the problem statement both defines the problem the planners will work to resolve, and bounds the potential solution set in relation to the problem statement. Other potential expressions of the problem, all with varying degrees of validity, will not be addressed as the planners move forward. The other expressions of the problem continue to affect the environment and can lead to crisis post resolution or plan failure during execution.

In science, potential solutions are offered as hypotheses, subject to refutation by others. Hypotheses are not necessarily proven, but gain acceptance over time as they stand against repeated attempts to disprove them. If a hypothesis is disproved, there is no sanction against the individual who proposed it. In planning, the planner is responsible if either the problem statement or resulting action are wrong. The essential objective of planning is not to find the truth; rather it is to change the world to a preferred state. In the military context, operations conducted to arrive at resolution of the problem as defined by planners cause destruction. They often result in friendly casualties as well as enemy. If the planner failed to define the problem adequately, or chose a course of action that failed to resolve the problem, there are real world consequences and those consequences are, more often than not, life and death. The planner is liable for the result of his work and must start anew in the attempt to move the world as it is to the world as he wishes it to be.⁸

These essential truths of wicked problems do not mean the Joint Force should stop planning. As General Eisenhower said, even if a plan is useless, “planning is

⁸ Rittel and Webber, “Dilemmas in a General Theory,” 166-167.

indispensible.”⁹ While any planning process has utility, Joint Force planners, and their commanders, must be cognizant of the likelihood that planning will not, as a rule, produce the specific outcome the resulting plan suggests. From this, it becomes an imperative for the Joint Force to be both agile and adaptive. The quicker the Joint Task Force (JTF) commander recognizes a discrepancy between conditions the plan envisioned and conditions as they are, the more likely the Joint Force will succeed in the mission. The ability to recognize anomalies, decide on actions to address the anomalies, and to execute those actions, defines agility and adaptability. Commanders must guard against viewing plans as predictive; a linear thought process that has little utility in today’s environment. If the going in position is that the plan will not survive, the Joint Force mitigates against the logic fallacy that the plan is an accurate representation of reality and is more likely to recognize, and react rapidly and effectively, to changes in the environment.

All postulates defining wicked problems can be explained by judicial application of complexity theory. Complexity can be defined broadly as any system with a very large number of parts, each of which interacts with each other. As each part of the system interacts with others, it responds as one on a series of interdependent variables. The result is a system which cannot be predicted in detail. As each element within the system acts on all other parts with which it is connected, it is in turn acted upon. Each interaction results in a change in behavior of each interdependent element. Further, very minute changes in behavior by any of the discrete elements may cause enormous changes in the system as a whole, particularly if it occurs early in a chain of interactions.

⁹ President Dwight D. Eisenhower as quoted by Richard Nixon in *Six Crises*, (Garden City, NY: Doubleday and Co, Inc, 1962), 235.

Conversely, relatively large behavior changes may result in little to no systemic impact over time.¹⁰

Solutions or solution sets must not be judged by their efficiency, or by their applicability to first-order effects. They can only be judged in the context of their utility measured in terms of specified National interests against the costs to implement, both in blood and treasure, and in terms of their unintended consequences which very well may be antithetical to other, seemingly unrelated, National interests. In some ways, any course of action at the strategic level intended to advance the National interest might negatively impact a different, yet equally important National interest. There is no definitive solution to a complex problem, only varying degrees of efficacy against multiple indicators of success, balanced against potentially negative impacts to other indicators of success.

How then do we, as a Joint Force, deal with wicked problems? One possible answer is “Design.” Joint Warfighting Center (JWFC) PAM 10, “Design in Military Operations” defines design as “a repeatable methodology of reasoning that that helps commanders understand how to change a complex-adaptive system from ‘what is now’ to ‘what is feasible and better.’”¹¹ Because of the uncertainty and multiple interdependent variables inherent in wicked problems, it is not possible to predict how any military action will change the environment. Planners and commanders must remain skeptical about the expected outcome of any action. The design requirement to reframe the understanding of the operational environment and the approved operational approach as

¹⁰ This phenomenon is expressed in Chaos Theory. For a more complete explanation, see Garnett P. Williams, *Chaos Theory Tamed* (Joseph Henry Press, Washington, D.C. 1997)

¹¹ Department of Defense, Joint Warfighting Center, *Joint Doctrine Series Pamphlet 10: Design in Military Operations – A Primer for Joint Warfighters*, Joint Forces Command (Norfolk, VA, 20 September 2010), 3.

part of a continuous process offers the commander the opportunity to recognize that the environment is not responding as the operational approach expected. When combined with continual assessment of conditions the Joint Force commander and staff can modify the operational approach in response to unexpected changes (or lack of changes) in the environment, increasing the chance of achieving desired objectives.¹²

Further, we must link the outputs of design to a planning and execution construct that results in maximum freedom of action at the tactical level. Any product of a relevant planning process in a complex environment must eventually be expressed in an order, operationalizing the plan. Those orders are necessarily colored by the plan produced using the Joint Operational Planning Process (JOPP). As a result, orders are themselves a further manifestation of a linear, Newtonian view which we know to be a flawed paradigm when describing, then acting to solve, complex problems. Just as strategic level planning is evolving to meet the requirements posed by wicked problems in a complex world, so must operational planning and tactical execution.

At the operational level, the Joint Force is confronted with wicked problems set against a rapidly changing operational environment. In a context of democratic information flow overlaid on convoluted social systems, themselves subject to multiple change agents, it is not possible to forecast events or outcomes with any degree of accuracy. It is, therefore, an absolute requirement to field an operational and tactical force capable of adapting to conditions as they are, not as the strategic commander and planners predicted conditions to be. To do so, any doctrinal approach to operationalizing and subsequently executing a strategic level plan requires maximum freedom of action and concomitant decision space at both the operational and tactical levels. If we

¹² Department of Defense, Joint Warfighting Center, *Joint Doctrine Series Pamphlet 10*, 4.

conceptualize command and control as a continuum, we must default to the least restrictive construct possible in order to empower operational and tactical commanders as they conduct military operations in prosecution of National interests and strategic goals.

The Department of Defense recognizes the need for increased understanding of the impact of modern information technology on National security interests. In an effort to bridge the technical, educational, analytical, and operational communities, DoD established the Command and Control Research Program (CCRP) with the mission of improving DoDs understanding of the impact of the Information Age on National security. The CCRP sponsors a broad range of research initiatives, including study of command and control theory in order to improve both the state of the art and the state of practice in the Joint Force.¹³ Dr. David S. Alberts and Dr. Richard E. Hayes have collaborated on a number of research efforts under the auspices of the CCRP and are the authors of a number of contemporary studies on command and control in general, and command and control in the Information Age specifically.¹⁴

Their research into command control in the Information Age produced a new concept they termed “power to the Edge.” Edge principles are derived as a response to complexity, taking a distributed network approach to deal with uncertainty and rapid change. The concept is based on delegating power (authority and responsibility) to individuals at the edge of the organization, to those who directly interface with the

¹³ Department of Defense Command and Control Research Program, Mission Statement, “About the Program,” Command and Control Research Program, http://dodccrp.org/html4/about_main.html (accessed 4 March, 2012).

¹⁴ Dr. Alberts served as the Director, Research and Strategy, OASD (NII). He is a past director on the DoD sponsored Command and Control Research Program, responsible for the Center for Advanced Concepts and Technology at the National Defense University. Dr. Hayes is President and founder of Evidence Based Research, Inc. and specializes in multi-disciplinary approaches to command and control, intelligence, and national security issues. His areas of expertise include military command, control, communication and intelligence; and decision aiding systems.

environment. In the military context, “power to the Edge” is about allowing subordinates to make decisions. With this comes an increased requirement for access to information (laterally as well as vertically) and removal of restraints related to the organization and control of elements of the force.¹⁵ This is not to say remove control completely, but to exercise control through bounding decision space, resources available, and a common understanding of the desired end-state. Rules of engagement, for example, would still be a necessary part of any command and control system rising from Edge principles.

Edge organizations are characterized by increased peer-to-peer communication and relationships. Mid-level management is reduced as their role is primarily to manage control measures and analyze and pass information up and down the command chain. In Edge organizations, command is separated from control, moving from command and control to command and influence. In effect, commanders are responsible for setting conditions and providing resources.¹⁶ Unity of effort comes from a shared understanding of commander’s intent, training, and trust. The control function is imposed by subordinate commanders and units on themselves as they operate within intent and rules of engagement. This approach has worked for armies in the past – examples include the Battle of Trafalgar and the Battle of Stalingrad. Brief case studies of these battles follow to illustrate both the ideas expressed in this chapter, and the success of those ideas when applied to military operations.

¹⁵ David S. Alberts and Richard E. Hayes, *Power to the Edge: Command and Control in the Information Age*, (Washington, DC: Department of Defense Command and Control Research Program, June 2003), 5.

¹⁶ Ibid., 6.

The Battle of Trafalgar

On 21 October 1805, Admiral Horatio Nelson entered immortality commanding the British Grand Fleet in action against the combined Franco-Spanish Fleet. After a battle lasting over six hours, the British fleet had won the day. Twenty-seven British ships of the line had bested thirty-three Franco-Spanish ships. The British did not lose a single ship, although half the fleet suffered significant damage. Total British casualties totaled 1700, including the death in action of Admiral Nelson. The Franco-Spanish fleet lost 17 ships, with one sunk and 16 captured. Four surviving French ships were captured two weeks later on November 4. Total casualties to the combined fleet were 2,600 dead or wounded with another 7,000 captured.¹⁷

Admiral Nelson developed a battle plan in which his fleet would divide into three lines and sail through the Franco-Spanish line from the flank – a marked departure from the traditional trade of broadsides as the opposing lines sailed past each other. While not the first sea captain to do so, it was not a technique commonly in use.¹⁸ It was an exceedingly risky plan. When the British columns closed on the combined Franco-Spanish fleet, the bows and rigging of the lead ships in the British columns would be completely exposed to the combined fleet's broadside and would be unable to fire in return until the British lines actually began to cut the enemy line of battle. However, Admiral Nelson's crews did have a singular advantage. His gun crews could nearly triple the Franco-Spanish crews' rate of fire. Nelson's plan depended on cutting the combined

¹⁷ Jan Bremer, *The Burden of Trafalgar: Decisive Battle and Naval Strategic Expectations on the Eve of the First World War*, Newport Paper #6 (Newport, RI: Naval War College, 1993), 24.

¹⁸ Joseph HCallo, H"Lasting Lessons of Trafalgar," H*Naval History*HH 19, no. 5 H (Oct 2005): 16-17.

fleets line, then using his superior gunnery to defeat them in detail.¹⁹ On 9 October, Admiral Nelson shared his plans to break the Franco-Spanish fleet's line with his captains in a secret memorandum.²⁰ Admiral Nelson implemented the general intent of his memorandum by attacking the trailing two thirds of the Franco-Spanish fleet with two lines (rather than the three he originally envisioned) with his two divisions sailing roughly parallel. His effort to break the enemy line succeeded with the immediate effect of taking an entire third of the Franco-Spanish fleet out of the action by sailing away from the remainder of the line which was unable to maneuver quickly enough because of weak winds to rejoin the battle before decision. Although Admiral Nelson died from wounds suffered when a musket ball fired from the Redoubtable struck him in his back, the British had effectively destroyed the Franco-Spanish combined fleet.²¹

During preparations from the battle, and throughout the engagement, Admiral Nelson exercised a "control free" command and control method, trusting his subordinate commanders to complete their mission. He clearly communicated his intent and operational concept to his subordinate commanders, encouraged initiative, and trusted them to do what needed to be done. In turn, his subordinate's trusted him, executing their mission orders with highly trained and competent crews, defeating a numerically superior enemy through the use of an unconventional tactic.²² In Nelson's own words, "... after

¹⁹ William Welsh, "Nelson at Trafalgar: He Did His Duty," *Military History* 22, no. 7 (Oct 2005): 38-44.

²⁰ Lord Horatio Nelson, *August to October 1805*, Vol. 7 of *The Dispatches and Letters of Vice Admiral Lord Viscount Nelson; With Notes by Sir Nicholas Harold Nicolas, G.C.M.G.* (London: Henry Colburn), 66-67.

²¹ HCallo, H"Lasting Lessons of Trafalgar," 21-22.

²² Department of the Navy, *Navy Doctrinal Publication 6, Naval Command and Control*, (Washington, DC Government Printing Office, May 1995), 5.

the intentions of the Commander-in-Chief is signified, it is intended to be left to the judgment of the Admiral commanding that Line."²³

While the victory itself was of huge tactical significance, Nelson's approach to command and control is of primary interest. Admiral Nelson's use of what we now call mission command carried the day. Because of his approach to command, Nelson flew no tactical signals during the battle. His subordinate commanders did not require tactical direction from Admiral Nelson. They understood their mission and they knew Nelson's intent. When Nelson signaled the command that "England Expects that Every Man Will Do His Duty"²⁴ before the action commenced, his second in command and commander of the second line, Vice Admiral Cuthbert Collingwood, reportedly remarked that he "wished the commander would make no more signals, for they all understood what they were to do."²⁵ Looking back today, it is clear the Lord Nelson understood what we now call power to the Edge and that he employed edge principles at Trafalgar.

The Battle of Stalingrad

The Battle of Stalingrad began in 1942 and ended on 2 February 1943 with the surrender of the last German forces in the city. One of the greatest battles in history, the fight for Stalingrad produced over a half million casualties and lasted for seven months of fierce and relentless fighting.²⁶

General Friedrich Paulus, a brilliant strategist and planner, commanded the German 6th Army. He began his assault in Stalingrad in late summer of 1942 with the

²³ Nelson, *August to October 1805*, Vol. 7 of *The Dispatches and Letters*, 233.

²⁴ An alternate version of the story behind the signal may be found in "Nelson's Signal at Trafalgar," *The Washington Post (1877-1922)*, Dec 2, 1883, 3, originally published in *The London Herald*.

²⁵ Nelson, *August to October 1805*, Vol. 7 of *The Dispatches and Letters*, 233.

²⁶ For additional information on the battle and its implications Hitler's Third Reich, see S.J. Lewis, "The Battle of Stalingrad," in *Block by Block: The Challenges of Urban Operations*, ed. by William G. Robertson, 29-62 (Fort Leavenworth: U.S. Army Command and General Staff College Press, 2003).

crossing of the Don River. By 23 August, the 6th Army had reached the banks of the Volga River and the suburbs of Stalingrad. After two days of German bombing on 23-24 August, Stalingrad was in ruins.

The 62d Army commanded by General Chuikov, continued to defend the rubble of Stalingrad and Paulus' 6th Army found itself in a battle of attrition to take the city. Although an absolute master of mobile warfare, General Paulus was slow adapting to the urbanized fighting he faced in Stalingrad. Close quarters in the bombed out city and well-placed and fortified defensive positions manned by aggressive Red Army troops cancelled the German advantage of dominant maneuver. The German tanks could not move easily in the city and could not elevate their guns to engage Red Army defenders in upper stories of buildings and atop piles of rubble. Key terrain was held by Red Army troops, forcing the Germans to turn into nearby streets pre-registered for artillery and observed by Red Army spotters. Between September and November 1943, Paulus launched three major assaults to take the city, all of which failed, leaving Stalingrad in the hands of the defenders.

While General Paulus continued the German attempt to take the city, the Red Army planned and prepared for a counter-offensive to relieve the siege of Stalingrad. Code named Operation Uranus, the offensive would encircle Paulus' 6th Army and the 4th Panzer Army supporting Paulus' attack on Stalingrad. Operation Uranus, involving over one million Russian soldiers, began on 19 November and completed the encirclement of German forces on 23 November. German forces were now defending themselves against Russian forces in the city, as well as to their rear and flanks. The German Luftwaffe was unable to resupply General Paulus and his remaining 250,000 soldiers. The 6th Army

held out for three weeks. On 31 January 1943, Paulus' Headquarters was overrun and Paulus surrendered, with the last remaining German forces surrendering two days later.²⁷ After the German defeat at Stalingrad, the German army was in nearly constant retreat from the Red army.²⁸

There are many lessons to be gleaned from study of the Battle of Stalingrad, but those relating to agility of mind and freedom of action are most relevant to this thesis. Although a brilliant strategist and planner, General Paulus did not recognize the changing nature of the battle he was fighting and consequently did not adapt his style of iron-clad command and control to meet the demands of the situation he was in. Throughout the battle, General Paulus' forbade independent changes to the plan and this failure to delegate decision authority to his tactical commanders prevented them from exploiting opportunities. Paulus was a "planner" sticking rigidly to a pre-planned sequence of actions; by restricting the ability of his commanders to use their own initiative he moved from the German military doctrine of mission-oriented command which specifies what to do but not how to do it²⁹ Had Paulus allowed his subordinate commanders freedom of action, and resourced them appropriately, it is very possible that he would have taken Stalingrad and altered the course of the war.

General Chuikov and the Russian 62d Army, however, demonstrated remarkable agility of mind throughout the siege of Stalingrad. Focusing on the Red Army instead of on the Germans uncovers a number of examples of sense-making and improvisation

²⁷ S.J. Lewis, "The Battle of Stalingrad," in *Block by Block: The Challenges of Urban Operations*, ed. by William G. Robertson, 29-62 (Fort Leavenworth: U.S. Army Command and General Staff College Press, 2003), 31-46.

²⁸ Brian Hanley, "The Enduring Relevance of the Battle for Stalingrad," *Joint Forces Quarterly* Issue 43 (4th Qtr 2006): 92.

²⁹ Malcolm Brady, "Improvisation versus Rigid Command and Control at Stalingrad," *Journal of Management History* 17, no. 1 (2011): 36-37.

which combined to form an adaptive and agile force. Leading up to the battle, constant retreat eastward and seeing the destruction of the Rodina had demoralized the Russian soldier. Finally, in the City of Stalingrad, Chuikov established a policy of aggressive defense, ordering the 62d Army to stand fast and defend the city while attacking back at every opportunity. This concept of active defense was designed to force the German Army to abandon the attack. His concept of active defense had many critical impacts on the outcome of the operational fight. Throughout his defense, Chuikov countered the German force's strengths and exploited the gaps in German capabilities, successfully changing the character of the battle away from maneuver to a battle of attrition, forcing Paulus and the German 6th Army to fight desperately for every inch of the city.³⁰

To implement his active defense, Chuikov moved to counter German advantages. The reluctance of German pilots to bomb in close proximity to their own line, Chuikov deployed the 62d Army within hand grenade range of German troops wherever possible. He emplaced defensive positions in rubble buildings to break up German advances which depended on armor support to German infantry. Chuikov changed the task organization of the 62d Army. Rather than maintaining battalions and regiments, he reorganized them into smaller, agile and lethal "Storm Groups." These storm groups and their tactics were Chuikov's most significant improvisation. While conventional formations manned defensive positions, these storm groups of lightly equipped Russian soldiers attacked German positions, usually at night, to clear them of elements of Paulus' 6th Army. Chuikov's use of storm groups was an atypical and asymmetrical use of the 62d Army's smaller numbers of soldiers and exploited Paulus' reluctance to fight at night. The use of these smaller, semi-autonomous storm groups necessitated a change in

³⁰ Hanley, "The Enduring Relevance," 91.

the 62d Army's command and control structure. When operating independently, storm group commanders had virtually unlimited authority to execute actions without approval from a higher command echelon. This continuous adaptation by small unit commanders was a key part in Chuikov's success throughout the Battle of Stalingrad.³¹

General Chuikov's aggressive defense of Stalingrad depended on three unconventional ideas. First, his willingness to invest positions that hugged German lines was extremely effective in reducing the German Luftwaffe's ability to effect the situation on the ground. Second, the task organization change from conventional large formations to shock groups capable of independent action changed the character of the siege of Stalingrad to a battle of attrition, one the German 6th Army was unprepared to fight. Finally, General Chuikov's willingness to relax the Red Army's rigid command and control structure allowed small unit tactical commanders to take action to exploit whatever opportunity appeared. These adaptations, under fire made it possible for the Russian 62d Army to defeat a numerically superior Army who enjoyed the benefit of air superiority. Chuikov's mental agility in recognizing Paulus' potential vulnerabilities, and rapidly acting to exploit them, was an unqualified operational success. The reorganization of conventional formations into small shock groups required the relaxation of command and control hierarchies. The resulting distributed decision making ceded power from the Army commander to the edge. The innovation of subordinate commanders at the tactical level provided the Army commander with an operational and strategic victory.

³¹ Brady, "Improvisation versus Rigid Command," 37-39.

At Trafalgar and Stalingrad, Lord Nelson and General Chuikov formed and promulgated clear intent, and delegated decision authority to subordinates. Both Lord Nelson and General Chuikov had a high degree of trust in their subordinate commanders. Both commanders applied innovative schemes of maneuver and task organization specifically optimized to exploit their respective adversaries. During both battles, subordinate commanders recognized and exploited opportunities without waiting for instructions from higher commanders. The style of command exhibited by Lord Nelson and General Chuikov employed the concepts that define “power to the Edge” and bear remarkable similarity to the tenets of mission command.

CHAPTER 2: COMMAND AND CONTROL - WORDS HAVE MEANING

“Once upon a time, everybody understood what military commanders did. They commanded. This was simple enough and sufficient for a thousand years and more. In the complexity of the late twentieth century, however, it was insufficient. Whatever its virtue in brevity and clarity, the concept was wanting in prestige. So suitable steps were taken. Henceforth, commanders would no longer command. Commanders would *exercise* command. This would be much better.”

-- Greg Todd, “C1 Catharsis,” *Army*, February 1986.

Since “command and control” is not simply the sum of its parts, joint doctrine also carefully defines the constituent elements of command and control. Command is “the authority that a commander in the armed forces lawfully exercises over subordinates by virtue of rank or assignment.”¹ This authority explicitly links command to responsibility under statute. With command authority comes the responsibility to “effectively organize, direct, coordinate, and control military forces to accomplish assigned missions.”² The authority over subordinates carries additional responsibilities for commanders for maintenance of discipline and for the health, welfare and morale of all personnel assigned to the command and subject to the commander’s authority. Command also includes the authority for resourcing decisions and the responsibility to use available resources directly.

In any gathering of military professionals, it is virtually guaranteed that any discussion of command and control will generate considerable discussion. The way “command and control” is defined bounds our understanding both of the terms and of the processes and systems associated with command and control. Those limitations, imposed

¹ Chairman, Joint Chiefs of Staff, *Joint Publication 3-0, Joint Operations*, (Washington, DC, August 2011), II-1.

² *Ibid.*

by the language we use, limit our ability to execute those functions command and control systems are designed to do.

Already a rather esoteric subject, the study of command and control has become significantly more difficult, and what command and control really means is not well understood by many of those who practice it. How any given commander understands command and control has a great deal to do with the perspective from which the commander approaches the subject. Some see command and control as the people involved. Others see it as the unit (usually a headquarters). Still others view command and control as the technological means by which command is exercised. Finally, there are some who define command and control as the various processes and systems that work together to synchronize and direct the actions of subordinate. In contemporary use, however, command and control is a commander and a system that work together encompassing each of the previous perspectives.³

Definition of terms is central to common understanding and forms a large part of U.S. doctrine. Most doctrinal publications include a glossary of terms to ensure that terms are used consistently and understood the same way by all. That is, that all involved in planning and executing operations use a shared vocabulary to promote universal understanding. Why then does the term “command and control” mean so many different things to so many people? In part, the sheer number of different meanings for command and control, depending on which doctrine is in use, combined with the separate and distinct doctrinal meanings for the terms “command” and “control” individually, ensures any conversation on what command and control really means will be a lively one. To

³ Department of the Army, *Field Manual 6-0, Operations* (Washington DC, Government Printing Office, August 2003), 1-5.

illustrate, within the DoD, there are at least six different definitions and explanations for “command and control.”⁴ In an attempt to promote service interoperability, the Joint Staff has gone through significant effort to formulate and publish doctrine to ensure that the Joint Staff, Combatant Command staffs, and subordinate Joint Task Force staffs all “speak the same language.”

In the most reductionist sense, command and control is that function that must be executed for the Joint Force to exist and to operate.⁵ It consists primarily of making, then executing, a commander’s decisions. Most modern command and control systems and processes exist to reduce the “fog and friction” of combat in an attempt to improve the commander’s understanding of the battlefield and to direct forces to act according to the intent of the commander. These systems are based on the idea that it is possible, within bounds, to control the operational environment and those who act within it through industrial age management processes based on cause and effect relationships.

The Joint Force emphasis on control remains an effort to address Clausewitz’ concepts of the fog and friction of war to avoid the effects of chance. “In short, absolute, so-called mathematical, factors never find a firm basis in military calculations. From the very start there is an interplay of possibilities, probabilities, good luck and bad that weaves its way throughout the length and breadth of the tapestry. In the whole range of human activities, war most closely resembles a game of cards.”⁶ In military operations, at any level, we must account for chance as we account for risk. At the point of decision,

⁴ JP 1-02 provides a universally accepted definition of “command and control” common to all the services. Additional information and explanation of “command and control can be found in JP 3-0, and in doctrinal publications from each of the services including AR 3.0 and 6.0, NDP 6, AFDD 2-8, and MCDP 6.

⁵ Martin Van Creveld, *Command in War* (Cambridge, Massachusetts: Harvard University Press, 1985), 5.

⁶ Clausewitz, *On War*, 97.

a competent commander with the authority to act outside the bounds of the plan can adapt to counter the effects of chance.

As the means of waging war have gotten more complex, information requirements have increased to support ever more-complicated decision support tools. Advances in information technology have made collection of incredible amounts of information possible. Combined, these two developments generally result in one of three outcomes, only one of them good. Best case is a well-informed commander, with a clear and correct understanding of the environment, making a good decision based on the right information at the right time. Two more likely outcomes are first, a commander so awash in information, he or she is simply unable to process all the information available and act, leading to a decision too late to affect the outcome or a commander who sifts available information, but does not choose correct and relevant information, leading to a potentially catastrophic decision. Second, the effort by a commander and staff to process information and arrive at decisions becomes so extreme, that they come to view the process itself as the point of the exercise, arriving at last at a command and control system that does not influence events, but demands information, effort, resources, and time solely to feed a process - an end in and of itself.

The art and science of command is not intended to produce command and control, that is, it is not an end unto itself. It is intended to produce a specific end-state or states within the operational environment. An inherent risk in dependence on heavily process-driven or automated control systems is that it can lead to a belief that the plan itself is the desired result. Nothing could be further from the truth. Everything a commander and staff do to exercise command and control is designed to focus “the efforts of a number of

entities (individuals and organizations) and resources, including information, toward the achievement of some task, objective, or goal.”⁷ HOW we achieve the commanders intent is not nearly as important as THAT we achieve it.

Thomas Czerwinski organizes approaches to command and control into three types; command by direction, command by plan, and command by influence. Each method has some of its principles embedded in modern command and control systems and processes. None is necessarily appropriate for all situations. They can be applied simultaneously by a single echelon of command against different joint functions, and are not mutually exclusive when practiced at differing echelons of command.⁸

Command by direction was state of the art from earliest recorded history through Fredereick the Great. Frederick’s efforts to command his entire Army at once, all the time, is the apotheosis of command by direction. In current practice, command by direction is usually applied only at the lowest tactical level, generally at the fire team or squad leader level. Command by plan is centered around detailed planning at a much higher command level and is characterized by a great deal of detail with decision-making centralized, leaving little to no decision room at lower command echelons. Examples of command by plan include Time Phased Force Deployment Data (TPFDD), Master Air Attack Plans, and the Air Tasking Order (ATO). Command by influence is by nature decentralized. Under this construct, commanders share their vision of the environment as it is, and as they wish it to be. Execution depends on a shared understanding of the commander’s intent. The commander’s ability to describe his vision and a high degree of trust in subordinate commanders is necessary. In command by influence, decision-

⁷ David S. Alberts, and Richard E. Hayes, *Understanding Command and Control*, 32.

⁸ Thomas Czerwinski, “Command and Control at the Crossroad,” *Parameters* (Autumn 1996): 124-126.

making, within pre-established bounds, is shared among a number of subordinates.

Using Czerzinski's definition, command by influence is the intellectual foundation underlying Army and Marine Corps doctrine of mission command, itself derived from the WWII era German concept of "Auftragstaktik"⁹ and is analogous to Alberts' and Hayes' concept of power to the Edge.

Movement to the Joint Force as an Edge organization is not as radical as it may appear at first look. Review of the literature shows there was not a single "best practice" to exercise command and control in the Industrial Age. In the last 100 years, there have been six distinct approaches to command and control identified in industrialized militaries. All were successful in the circumstances in which they were implemented. It is helpful to think of command and control as occurring on a spectrum from most restrictive (least agile and adaptable) to least restrictive (most agile and adaptable). In order from most to least restrictive, those approaches are:

- 1) Cyclic
- 2) Interventionist
- 3) Problem solving
- 4) Problem bounding
- 5) Selective control
- 6) Control free¹⁰

⁹ "Auftragstaktik" represents capstone command and control doctrine in the German Armed forces dating back the early 19th century. Roughly translated, auftragstaktik combines mission orders and command by influence. Based on task and situation, commanders tell subordinates what to do but not how to do it. The commander provides subordinates the maximum freedom of action possible within the higher commander's intent. See David M. Keithly and Stephen P. Ferris, "Auftragstaktik, or Directive Control, in Joint and Combined Operations," *Parameters* (Autumn 1999): 118.

¹⁰ Alberts and Hayes, *Power to the Edge*, 18.

Each approach is optimized for a specific philosophy of control overlaid on the understanding of the operational environment.

The cyclic control approach is characterized by very detailed orders issued on a predetermined, regular schedule. It is a preferred method when commanders are limited by communications capability that cannot meet requirements for real time communication. It is also used when the actions of separate forces are interdependent and require detailed coordination to accomplish an objective, or when the force receiving the order does not have the capability or the imagination to develop their own approach to accomplish the mission. It works best when there is sufficient time for the higher headquarters to gather and analyze information, and to prepare and issue the order. Cyclic approaches are extremely inflexible and require great effort at the tactical level to execute in the face of a determined, adaptable enemy. It is often a brute force approach at the tactical level and prone to failure if an adversary does not act or react according to the plan. This approach was favored by the Soviet Army during WWII and is the basis behind the contemporary U.S. Air Force ATO.¹¹ Cyclic command and control processes are examples of “command by plan” philosophies.

In the interventionist approach, a theater headquarters still issues detailed orders to the force, selecting objectives and specifying how those objectives will be met. Unlike cyclic approaches, the orders are not issued on a regular schedule. This seemingly small difference allows the central headquarters to react to changes in the operational environment or previously unidentified threats. This method of command and control requires better communications nets and a more competent force than the cyclic approach. This approach is characterized by predetermined actions the operational force

¹¹ Alberts and Hayes, *Power to the Edge*, 20.

will take. It relies on execution of an optimum solution, usually ensconced in doctrine, to accomplish specified objectives. In effect, the interventionist approach relies on operational level battle drills. Like a football playbook, the theater commander calls a play and operational commanders execute. Like the cyclic approach, interventionist models do not allow for initiative from subordinate commanders. They are vulnerable to an adversary who understands “the playbook” and on the central headquarters “calling the right play.” Interventionist command and control approaches, like cyclic approaches, are examples of a “command by plan” philosophy. The Cold War-era Soviet Army used an interventionist command and control approach.¹²

The problem solving approach is the first and more restrictive of two command and control approaches that invite subordinate commanders to solve their own tactical problem sets. In a problem solving command and control approach, the theater headquarters establishes and communicates objectives to the operational headquarters. This approach, used by the U.S. Army in WWII, requires operational commanders to devise their own approach to meet centrally selected objectives. Within bounds of restraints and constraints imposed by a higher commander, operational commanders are generally free to develop and execute their course of action.¹³ In the command and control spectrum, Problem solving approaches are the most restrictive approaches that still allow for initiative and insight from operational and tactical commanders. They are significantly more flexible than Cyclic and Interventionist approaches and require a much higher level of training, education, and initiative. This approach best characterizes U.S. command and control in the early years of WWII.

¹² Alberts and Hayes, *Power to the Edge*, 22.

¹³ Ibid., 23.

Problem bounding is best described as a less restrictive approach to Problem Solving. During the Cold War, British orders were about two-thirds shorter than U.S. orders. British commanders generally imposed fewer restraints and constraints on subordinate commanders. Orders identified more possible contingencies, but did not provide any significant detail in orders to subordinate forces, allowing operational commanders to develop their own solutions that best fit the situation on the ground. This approach places fewer constraints and restraints on operational commanders, effectively increasing the decision space allocated to the subordinate commander. Problem bounding is the most restrictive form of command by influence and describes U.S. command and control in experienced units in the later years of WWII.¹⁴

Selective control places minimal controls on the operational force and is characterized by the Joint Force commander's focus on missions rather than on objectives or plan execution. In a selective control approach, operational commanders are free to select objectives within the theater commander's intent, then to execute operations without interference from higher. The theater commander's role is to select broad missions and assign them to highly capable and competent forces. This philosophy is differentiated from "control free" through recognition of the theater commander's responsibility to intervene when new threats or opportunities present themselves. This approach to command and control requires excellent communications between units both horizontally and laterally as operational and tactical commanders share information and coordinate to synchronize activities to achieve the theater commander's desired end state. This system is currently in use by the Israeli Army, and assumes that subordinate commanders, used to operating with nearly complete autonomy, will react rapidly and

¹⁴ Alberts and Hayes, *Power to the Edge*, 23-24.

effectively to changes in intent. It also requires a great deal of discipline from higher commanders who must resist the urge to intervene unless a major change occurs in the environment making it impossible for the subordinate commander to respond effectively with the resources at his disposal.¹⁵

In a control free approach, the only responsibility of the theater commander is to assign missions and resource the operational force. This resourcing requirement continues throughout the campaign as additional resource requirements, including information, are levied on the theater commander as operational commander's maneuver and engage to complete successfully their assigned mission or mission set.¹⁶ At the outset of WWII, the Wermacht used this command and control approach to great effect through the concept of "Auftragstaktik" or mission command. German Corps Commanders had incredibly high levels of autonomy. During Operation Shingle, the Allied landing at Anzio, a German Corps Commander with his staff in Italy for rest and recuperation was ordered to take command of all German forces in the region and contain the Allied landing. He was successful, delaying the Allied forces from liberating Rome. This type of command and control philosophy is relatively rare since the invention of the telegraph.

The same advances in communications which made Control Free philosophies increasingly effective also made control free approaches less likely as senior commanders exploited their ability to stay in touch. The fear of losing control of a major engagement makes it difficult for higher commanders to allow subordinates freedom of action. This fear led the Israelis to choose selective control over control free, even though a control

¹⁵ Alberts and Hayes, *Power to the Edge*, 24-25.

¹⁶ Ibid., 25.

free approach is potentially the most effective means of command and control in the industrial age.

Both selective control and control free approaches are examples of moving power to the edge. Neither approach abrogates the need for command. The senior commander remains responsible for developing, then promulgating clear intent and ensuring subordinates have consistent understanding of the intent. He also remains responsible for adequately resourcing the operational force, and for reallocating resources and providing information to the subordinate commanders as the campaign progresses.¹⁷ Further, less restrictive command and control approaches are not always preferred.¹⁸ It remains the responsibility of the theater commander to choose an appropriate command and control method for the situation or mission.

When choosing an appropriate command and control approach, the Joint Force Commander must recognize the impact of information technology on the ability of the force to process and disseminate information. Less restrictive command and control approaches rely on both quality information available to the decision maker, and on a shared understanding of the commander's intent. Information technology can enable both. Since the Joint Force has the information capability to support less restrictive command and control approaches, there are fewer and fewer situations where more restrictive command and control approaches are necessary.

If more restrictive approaches are not necessary they should not be employed for two main reasons. First, retaining decision authority at a central node takes time, which

¹⁷Alberts and Hayes, *Power to the Edge*, 27.

¹⁸ Employment of the Nation's nuclear weapons is a prime example of the occasional need for more restrictive C2 arrangements. No one can reasonably argue that a launch officer should have freedom of action to decide whether or not to launch, or choose a target for his or her weapon.

at the tactical level is an exceedingly precious resource. The time spent waiting for a higher commander's decision prevents subordinate commanders from exploiting opportunities or reacting quickly to changes in the environment. Retaining decision authority reduces the agility of force at the edge. Second, restrictive command and control approaches assume the higher commander has an accurate understanding of the environment at the edge. While advances in information technology do provide a vastly improved common operating picture, they do not necessarily provide improved understanding of the environment. A decision maker present at the edge will have a more complete understanding of the environment at the point of decision, and therefore be in a better position to decide on and execute an appropriate course of action.

CHAPTER 3: COMMAND AND CONTROL IN DOCTRINE

“The LORD said, ‘If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them.’”

-- Genesis 11:6 NIV

Joint Doctrine

Joint Publication 3-0 defines command and control as “the exercise of authority and direction by a commander over assigned and attached forces to accomplish the mission. The JFC provides operational vision, guidance, and direction to the Joint Force.”¹ Command and Control is so critical to conducting military operations that it is specifically designated as a Joint Function.

At any level, command is simply the responsibility of a single individual to direct the actions of subordinates and of the organization, and to inspire and motivate them to accomplish organizational goals. The authorities granted commanders are necessary for the conduct of operations, but are not sufficient. The actual exercise of command requires a process or processes to ensure commands are followed, and that the actions of subordinate units and those personnel assigned support accomplishment of the tasks they are assigned. Collectively, those processes form the control function.

While joint doctrine provides four discrete definitions for control, within the command and control context the relevant definition of control is “authority that may be less than full command exercised by a commander over part of the activities of

¹ Chairman, Joint Chiefs of Staff, *Joint Publication 3-0, Joint Operations*, (Washington, DC, August 2011), II-1.

subordinate or other organizations.”² Already contained in JP 1 and JP 3-0, this definition has been approved for inclusion in JP 1-02.

Clearly, joint doctrine draws a sharp distinction between the human element in a command and control system (the commander) and in the technical element (control). Historically, organizations with a strong executive tend to outperform organizations centered on committees or processes. In a military context, this observation translates to commander-centric organizations out-perform staff-centric organizations. This concept is thoroughly incorporated into United States Joint Force and service doctrines. By custom and by law, commanders at all levels make decisions and direct activities, both in peace and in war.

At all levels of command, the commander’s perspective and access is significantly more comprehensive than that of the staff as a group. It is this relationship between the commander’s experience, knowledge, and situational awareness that informs the decision framework we call the “art” of war. Commanders proficient in the art of war produce clear, easily understood guidance and intent, enriched by the commander’s experience and intuition, and are a necessary precondition to high-performing units. Execution of the “art” of war, the commander’s overarching role throughout human history, is still critical to high performing units, no matter the technological level or proficiency of the force. Even in today’s highly complex, technical, interconnected world, this human element remains the central organizing and controlling force in the planning, resourcing, and execution of operations.

The “science” of war is expressed in the execution of the control function. The transmission of orders, assessment of progress, and the communication that make it

² Chairman, Joint Chiefs of Staff, *Joint Publication 3-0*, GL-8.

possible to direct forces engaged in operations, along with the rest of those tasks specified in joint doctrine and discussed previously, form the element of control.

Advances in information and communications technology allow significant improvements in both the efficiency and the effectiveness of control processes. These processes are central to executing the functions of command but regardless of technological advance or acumen, are subordinate to the command function.³

Extraordinary commanders recognize the primacy of the art, and understand the better they are at command, the less they need to control.

Service Doctrine

All U.S Service doctrine cites Joint Doctrine to define “command” as a preface to service definitions of “command and control.” The services diverge from there. Each of the services explains “command and control” differently. The Army and Marine Corps clearly place primacy on the commander and by extension, on the command element of command and control. The United States Navy and Air Force place greater emphasis on the control element when illustrating doctrine, particularly at the operational and strategic levels. The doctrinal foundations underlying service conceptualization of the command and control function inform officers from the sister services as they learn their craft and express themselves within the joint environment. Any attempt at reaching common understanding of command and control in a joint environment requires at least a cursory understanding of how each of the services defines and conceptualizes command and control.

³ Chairman, Joint Chiefs of Staff, *Joint Publication 3-0*, II-1.

United States Army

Army doctrine defines command and control as “the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of a mission. Commanders perform command and control functions through a command and control system.”⁴ Under this definition, the commander is explicitly designated as the focus of command and control. The commander makes decisions, and directs the actions of the unit, and the soldiers assigned thereto. Further, it is apparent from the definition that commanders exercise command and control in order to meet specific objectives and to accomplish successfully assigned missions. Implied in the doctrinal definition is the responsibility to use resources to best effect, and to prepare or position forces for follow-on and future operations. In addition to the joint definition of command, Army doctrine further defines command as consisting of three elements; authority, decisionmaking, and leadership.⁵ Additional definitions, and significant explication, are found throughout Army doctrine. This multiplicity of definitions for command lends to significantly diverse views throughout the Army on the exact meaning of command, and by extension, the precise meaning of command and control.

As with the rest of the sister services, the Army views control as inherent to command. The primary Army definition of control “is to manage and direct forces and functions consistent with a commander’s command authority.”⁶ Control is primarily science and includes all processes and systems necessary to direct forces, to assess actions and results, and to make necessary corrections to keep subordinate elements working to accomplish the assigned mission. Control is the mechanism by which

⁴ Department of the Army, *Field Manual 6-0*, 1-1

⁵ *Ibid.*, 1-1 – 1-4.

⁶ Department of the Army, *Field Manual 6-0*, 1-1.

commanders, to delegate authority to subordinates, to synchronize actions, to preserve freedom of action and direct the actions of subordinates, will providing the means to assess and report on the actions of his command and his subordinate commands.

Army doctrine also includes significant discussion on the relationship between command and control. The idea that they are inter-related is central to Army Mission Command Doctrine, and is expressed first in terms of the importance of the commander. Command rests with commanders, and there can be only one commander of any unit or organization. This principle supports unity of command. While command is primary in the relationship, in and of itself it is insufficient to direct operations, and the expression of command requires control. Command is expressed as “mostly art” with “some science.” Conversely, control is expressed as “mostly science” with “some art.” In this instance, art refers to the human judgment and intuition, based on knowledge and experience, the commander applies to a situation when making decisions and formalizing intent. Science refers to the study and understanding of a body of knowledge, facts, and processes. In Army doctrine, the art cannot be taught, but the science can.⁷

United States Marine Corps

Marine doctrine on command and control, contained primarily in Marine Corps Doctrinal Publication (MCDP) 6, begins with the idea that since war is “fundamentally a clash between independent, hostile wills” Marines will exercise command and control with the certain knowledge that they face a thinking, adaptive enemy bent on interfering with Marine operations. Recognizing that the enemy gets a vote, Marine Corps doctrine

⁷ Department of the Army, *Field Manual 6-0*, 1-3

“provides for fast, flexible, and decisive action in a complex environment characterized by friction, uncertainty, fluidity, and rapid change.”⁸

In Marine Corps doctrine, the command and control function is the single most important activity in war. While command and control does not press home the assault or defend against attack, no unit can carry out any other function without it. Without command and control, military units are essentially mobs, acting without purpose, reducing the application of force in pursuit of national goals to violence applied at random. For this reason alone, command and control is the most essential function a commander performs, and is necessary to any military operation. With effective command and control, a competent commander provides purpose to the force. That purpose, wedded to the commander’s intent, provides the direction for subordinate commanders and allows for disciplined execution, and mission accomplishment.

In Marine doctrine, “command and control” as that thing which “encompasses all military functions and operations, giving them meaning and harmonizing them into a meaningful whole.”⁹ This definition is sufficiently broad to include actions taken prior to undertaking an activity, actions while in conducting activities, and those actions performed after completing an activity. Training and commander’s intent are examples of pre-execution command and control. Tactical guidance from on-scene leaders to subordinates provides dynamic, real-time command and control during execution. After Action Reviews (AAR) provide a means for identifying those things done well and those things that were not done well, and incorporating them into future actions to improve performance as part of the commander’s requirement to assess operations.

⁸ Department of the Navy, *Marine Corps Doctrinal Publication 6, Command and Control*, (Washington, DC, October 1996), 2.

⁹ Department of the Navy, *Marine Corps Doctrinal Publication 6*, 34-36.

Marines measure effectiveness of command and control only in relation to an enemy and as a result, include protection of their command and control actions and their efforts to disrupt enemy command and control activities in their doctrinal discussion of control.¹⁰ MCDP 6 effectively redefines control away from joint doctrine. In the context of Marine doctrine, control is defined as “physical or psychological pressures exerted with the intent to assure that an agent or group will respond as directed.”¹¹

Actual control, to a marine commander, is unattainable in combat. For example, no commander can control weather, his level of resourcing, or the actions of a thinking enemy. While some of the listed uncontrollable elements can be influenced, the outcome of the commander’s influence cannot be predicted. More so than any other service doctrine, the Marine Corps doctrine explicitly states and discusses the complex nature of the environment, of war, and of military organizations themselves. Marines understand that with “a complex system it is usually extremely difficult, if not impossible, to isolate individual causes and their effects since the parts are all connected in a complex web.” Marine doctrine on command and control is predicated on application of chaos theory to command and control.¹² Doctrinal discussion of command and control within the Marine Corps acknowledges complexity as the defining characteristic of military operations, includes feedback as an essential element to respond to unforeseen changes in the environment, and accounts for unanticipated, non-linear outputs, and recognizes “that it is

¹⁰ Ibid., 38.

¹¹ Ibid., 140.

¹² Among other things, chaos theory posits that complex systems change over time, that behavior of complex systems is aperiodic and unstable, and that even though chaotic behavior is complex, it can have simple causes. It includes the axiom that complex systems are nonlinear, meaning that system output is not necessarily proportional to inputs and that the whole of any complex system is not equal to the sum of its parts. For further explanation of chaos theory as defined here, see Stephen Kellert, In the Wake of Chaos: Unpredictable Order in Dynamical Systems (Chicago, University of Chicago Press, 1993), Garnett P. Williams, Chaos Theory Tamed (Joseph Henry Press, Washington, D.C. 1997), p 7, and Alan Beycheren, Clausewitz, Nonlinearity, and the Unpredictability of War, in *International Security*, Winter 1992, p 62.

unreasonable to expect command and control to provide precise, predictable, and mechanistic order to a complex undertaking like war.”¹³ This idea marks a critical distinction between Army and Marine Corps doctrine and is critical to building a shared conceptualization of command and control in the Joint Force that accounts for the world as it is, not as we would like it to be.

United States Navy

United States Navy command and control doctrine has deep historical roots and was a necessary adaptation to the realities of a capital ship at sea. Command of a warship at sea required broad authority vested in the ship’s captain, and further required that his authority was undisputed.¹⁴ Prior to the invention of radio communications, Navy commanders, operating at sea, far from ground-based support, were expected make decisions without input from higher command. That traditional view of autonomous command is firmly entrenched in Navy service culture. The Navy stipulates that control must on occasion be directive but cautions commanders to balance their need to control actions with the diametrically opposed requirement of their subordinate commanders and sailors for freedom of action. Naval Doctrinal Publication (NDP) 6 rightfully identifies freedom of action as necessary to success in combat.

Navy doctrinal discussion identifies two primary methods of control. The first method is detailed control, characterized by explicit orders and is directive in nature with orders flowing down the chain of command, and information flowing up. Detailed control is the preferred method when time is not a factor or when the mission being conducted requires emphasis on procedures, such as maneuvering ships or conducting

¹³ Department of the Navy, *Marine Corps Doctrinal Publication 6*, 47.

¹⁴ Department of the Navy, *Navy Doctrinal Publication 6*, 9.

flight operations.¹⁵ As this control method is poorly suited for operations characterized by uncertainty or subject to time constraints, the Navy recognizes a second command and control method.

The second method, mission control, is decentralized and allows subordinates freedom of action to respond rapidly to changing conditions and is better suited for combat operations. Mission control is analogous to Army and Marine Corps mission command. The Navy, however, differs significantly by casting mission oriented orders as a control function, rather than a command function.

United States Air Force

The Air Force explains the relationship between command and control as one of “centralized control, decentralized execution.”¹⁶ This unique perspective on command and control is formalized in JP 1-02 as “In joint air operations, placing within one commander the responsibility and authority for planning, directing, and coordinating a military operation or group/category of operations.”¹⁷ The nature of air, space, and cyber operations demands a control construct that can efficiently and effectively direct very limited assets. Execution of operations in these three domains requires fusion of multiple capabilities under the direction of a single airman. For the Joint Force commander, this means that air forces will always be presented as a separate force.

To the Joint Force, the Air Tasking Order is probably the most familiar expression of air force command and control doctrine in action. While executed by subordinate

¹⁵ Department of the Navy, *Navy Doctrinal Publication 6*, 9.

¹⁶ Department of the Air Force, *Air Force Doctrine Directive 2-8, Command and Control*, (Washington, DC, June 2007), 12.

¹⁷ Chairman, Joint Chiefs of Staff, *Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms*, (Washington, DC: Government Printing Office, November 2010 [As Amended Through 15 January 2012]), 44.

units at the tactical level, the ATO is a centrally planned and controlled process that provides efficient use of all available aircraft at the theater strategic and operational levels. Air Force systems are optimized to provide sorties to support the ATO.¹⁸ The process output ensures airpower is available to support operational commanders. While tactical considerations can and do result in changes to the ATO during execution, authority to do so rests at the flag officer level.

¹⁸ Department of the Air Force, *Air Force Doctrine Directive 2-8*, 12-14.

CHAPTER 4: MISSION COMMAND

“In the final analysis, the helicopter's most pernicious contribution to the fighting in Vietnam may have been its undermining of the influence and initiative of small unit commanders. By providing a fast, efficient airborne command post, the helicopter all too often turned supervisors into oversupervisors. Since rarely was there more than one clash in any given area at any given time, the company commander on the ground attempting to fight his battle could usually observe orbiting in tiers above him his battalion commander, brigade commander, assistant division commander, division commander, and even his field force commander. With all that advice from the sky, it was easy to imagine how much individual initiative and control the company commander himself could exert on the ground-until nightfall sent the choppers to roost.”

-- Lieutenant General David Palmer, “Summons of the Trumpet.”

Mission command is derived from the Prussian (later German) doctrine of “Auftragstaktik.” Viewed through a United States ground forces doctrinal lens, mission command consists of writing and issuing mission orders, designed to tell subordinate commanders what to do, but not how to do it. Successful implementation of mission command assumes a number of necessary preconditions. Chief among them is a high level of trust between commanders at all echelons. Also required is a clear understanding by all of the commander’s intent. This is generally understood to mean understanding spanning two echelons of command. Mission command further assumes a great deal of professional competence at relatively low levels of organization (those commanded or led by lieutenants and ensigns) and communication and feedback processes that connect various command echelons and allow for rapid transfer of relevant information to subordinates and requests for resourcing and reports of progress to superiors.

Mission command consists of two complementary imperatives, mission orders and a clear, well understood intent. Mission orders assign missions or tasks to subordinate units, but do not attempt to direct or control how subordinate accomplish

those missions or tasks. Intent guides subordinate commanders in their execution by providing a frame in which the subordinate commander may act.¹ Together they provide the subordinates a clear description of what the commander wants done and how the commander envisions the operating environment at end state. Mission command is an achievable and effective form of command by influence.

Mission command fully addresses three critical requirements for command and control systems in the information age. The first of these requirements is for speed to achieve decisive action. The second is that maneuver cannot be planned in detail in advance requiring agility at the point of decision. The third requirement is to recognize that every problem in war is unique and requires competent, adaptive leaders to assess the problem, make timely decisions, and act appropriately.²

Speed in the context of modern joint operations can best be expressed as a constituent of tempo. Tempo is no more than operating at the speed of the problem. Commanders at all levels must develop the ability to recognize and understand problems and the environment, then act rapidly to exploit opportunities or counter vulnerabilities. An operational commander who retains decision authority voluntarily surrenders his ability to control tempo. Requiring subordinates to ask permission before acting risks surrender of initiative to the adversary while miring the operational commander in tactical detail.³ The more control measures and constraints placed on subordinate commanders, the more likely a subordinate is to ask for guidance prior to action with the concomitant increase in likelihood we lose the initiative or miss the window of

¹ David M. Keithly and Stephen P. Ferris, "Auftragstaktik, or Directive Control, in Joint and Combined Operations," *Parameters* (Autumn 1999): 118.

² John T. Nelson, "Auftragstaktik: A Case for Decentralized Battle," *Parameters* (September 1987): 23.

³ Major General Werner Widder, "Auftragstaktik and Inner Führung: Trademarks of German Leadership," *Military Review* (September-October 2002): 8.

opportunity. Distributing decision making to the maximum extent possible allows commanders at all levels the luxury of time to concentrate on those decisions only they can make while allowing the commander with the best understanding of the situation to make decisions without interference from a higher echelon of command and retaining initiative and the ability to exploit fleeting opportunities.

The recognition that maneuver cannot be planned in advance mirrors the strategic planning problem of responding to ill-defined, wicked problems. At the strategic level, commanders must constantly assess plans and consequently reframe the problem or adapt objectives. At the operational level, the Joint Force commander must assess operations and allocate resources or assign missions to adjust to the situation as it changes in response to tactical action. At the tactical level, commanders must have the freedom to decide and act in direct response to a thinking, responsive adversary. Attempting to “stick to the plan” in the face of an adaptive enemy is rarely the best response to a change in the tactical or operational problem. In mission command, the commander in contact has more than the authority to make and execute decisions within the operational commander’s intent, but also the duty to do so.⁴ This becomes exceptionally relevant today as we face more and more situations that were never even envisioned during planning.

Understanding that every problem in war is unique requires the Joint Force commander to delegate some authority. There are simply too many tactical decisions that must be made to require a single commander to make them all. Mission command allows the operational commander to describe the environment as he sees it, the environment as he wishes it to be, and to select and assign tasks to subordinate commanders to effect the

⁴ Nelson, “Auftragstaktik: A Case for Decentralized Battle,” 23-24.

changes required to produce the desired environment. The aspects of a particular tactical problem that differentiate it from other, similar problems are the responsibility of the tactical commander facing them. It allows for the fog and friction inherent in war by distributing decision authority to those in the best position to recognize a potential solution and to act.⁵ Mission command allows the tactical commander to respond rapidly to tactical problems using his or her best judgment maintaining tempo and retaining initiative. The operational commander is not required to maintain simultaneous awareness of both the operational environment within the joint operational area, and the tactical environment at the point of decision.

Control must be approached differently in the information age. It cannot be imposed on complex systems. This is particularly true when the system is adaptive as when facing a thinking, learning, adversary who will plan and act independently. Control, or “ensuring that behavior stays within or moving to within acceptable bounds, can only be achieved indirectly.”⁶ Command in a modern military must be a distributed function. A primary command function is timely decision-making. Any system or process whose execution takes longer than the time available for decision is flawed. We must adapt joint doctrine to reflect this. Curiously, both the Army and Marine Corps operate on the concept of Mission Command which attempts, within a hierarchical organizational structure, to push decision making authority to the lowest possible level.

Joint doctrine should be written to ensure operational commanders are focused on the operational objectives. Operational commanders are responsible for operational intent and operational design. They must focus on what it is the Joint Force must do, not

⁵ Nelson, “Auftragstaktik: A Case for Decentralized Battle,” 23.

⁶ Alberts and Hayes, *Power to the Edge*, 208.

on how the force will do it. Properly, operational commanders provide operational vision rather than on specifics of tactical action to achieve operational goals. Formulating and communicating this vision is the single most important function of the operational commander.⁷ In Clausewitz's words "...the supreme, the most far-reaching act of judgment that the commander makes is to establish the type of campaign upon which he is embarking."⁸ Mission command allows the operational commander to concentrate on the campaign, leaving the tactical execution to his subordinates. Mission command is one of the most successful methods yet employed to accomplish tactical missions in support of operational goals.

While mission command does address the three most compelling requirements the information age levies on the Joint Force, it does so at a cost. Implementing mission command will require changes in doctrine, in education, and in training. Those changes will be relatively easy next to the requirement to change organizational culture. To fully embrace mission command in the Joint Force, we must develop commanders willing to accept the risk inherent in empowering subordinate commanders to make decisions and act without unnecessary interference from higher commanders. Commanders must learn to develop clear, achievable intent and to communicate that intent to others. They must have the necessary listening skills to assess their subordinates understanding of the intent. Finally, commanders must engender the trust of their subordinates while trusting those same subordinates to act appropriately within the intent. Successful adoption of mission command as joint doctrine depends absolutely on commanders accepting the duty to

⁷ Keithly and Ferris, "Auftragstaktik, or Directive Control," 123.

⁸ Clausewitz, *On War*, 87-88.

coach, teach and mentor subordinates and to underwrite mistakes and accepting tactical risk.

The key element to formal adoption of mission command as joint doctrine is trust. The JFC must trust his subordinate commanders to act in accordance with his intent and be willing to accept tactical errors as the byproduct of empowered subordinates making decisions within their authority. Further, subordinate commanders must trust the JFC to clearly articulate and promulgate his intent while assigning subordinate units only those missions they are capable of doing. This mutual trust is a necessary precondition to implementation of mission command in the Joint Force. The benefit is the exponential increase in effectiveness as more and more leaders develop and display initiative. This expression of initiative is the key to a more agile and adaptable force, capable of effective response to the wicked problems of the information age.

The foundation for this trust is training and education prior to commitment of the Joint Force. A well trained force provides the foundation on which the commander places his trust in subordinates' ability to accomplish assigned missions. Well educated subordinate leaders have the critical and creative thinking skills necessary to develop the context necessary to recognize and problems and act to resolve them. This is the basis on which operational commanders are willing to accept tactical risk in the sure knowledge that enough subordinates at increasingly lower echelons will display initiative and make correct decisions. The tactical commanders' confidence in the operational commander's specific objectives and intent, the operational commander's confidence in tactical commanders' abilities, the unquestioned acceptance by tactical commanders of their duty to act, and the sure knowledge of their freedom to act are the keystones of mission

command.⁹ It is these vast numbers of subordinate leaders, acting at the intersection of action and environment that turn the Joint Force into an Edge organization and provide operational success.

Unfortunately, modern information technology makes it possible for strategic and operational commanders to make information demands at the lowest tactical level, leading to operational and strategic commanders directing tactical events, and for a flood of information to overwhelm commanders at lower levels operating with significantly less staff and information processing capability and capacity. The capability to collect and manage information leads inexorably to micromanagement at higher command echelons. These higher echelons tend to believe that they know better than subordinate commands. As a result, they tend to interfere with the actions of subordinate commanders in their mistaken belief that access to additional information makes them better qualified to direct action.¹⁰ Embracing mission command in joint doctrine provides a bulwark against this tendency and ensures that the appropriate commander retains both the authority and duty to act, freeing the operational commander from the mire of tactical decision making leaving him the time and decision space to address operational requirements.

Millennium Challenge 2002 provides an illustrative example of the concepts and arguments just discussed. The exercise was a wargame conducted in August, 2002 and was designed to test emerging concepts in “netcentric warfare.”¹¹ The exercise did not go completely as planned. Millennium Challenge pitted a highly networked,

⁹ Widder, “Auftragstaktik and Inner Führung,” 9.

¹⁰ Ibid., 8- 9.

¹¹ Norman H Friedman, H “Wargame Raises Questions,” *H United States Naval Institute Proceedings* HH 128, no. 10 H(Oct 2002): 4.

technologically advanced U.S. force against a conventional, joint (ground and naval) force and was set in Iran. Using edge organization and mission command principles, an inferior force demonstrated superior agility and adaptability, defeating a robustly networked force that could not recognize or adapt to the situation it faced.

Millennium Challenge 2002

Lieutenant General Paul Van Riper (USMC, Retired) commanded the opposing force. While U.S. forces won the exercise, LtGen Van Riper out-thought his U.S. forces counterpart, and forced the exercise director to reset the game and place significant constraints and restraints on the opposing force. Only two of LtGen Van Riper's tactical ploys were leaked, but both were used to good effect against the U.S. forces. The first was LtGen Van Riper's use of motorcycle couriers to carry his orders. This relatively low-tech solution defeated an array of sensors and collection platforms designed to intercept and exploit intelligence from Van Riper's headquarters.¹² U.S. forces knocked out modern communications links to force Van Riper's OPFOR to use satellite communications and cell phones to control his forces. Van Riper says simply "any moderately informed person would know enough not to count on those technologies... after what happened to Osama bin Laden in Afghanistan?"¹³ U.S. forces ignored a communications protocol their sensors could not penetrate. Van Riper continued to communicate and the U.S. forces were operating blind.

The second was an attack against U.S. capital ships in the Straits of Hormuz using a flotilla of small boats. After days of maneuvering in the Straits, a coded signal in the evening call to prayer triggered a series of attacks by OPFOR boats that culminated in the

¹² HFriedman, H "Wargame Raises Questions," 4-5.

¹³ Malcolm Gladwell, *Blink: The Power of Thinking Without Thinking*, (New York: Little, Brown and Co, 2005), 109.

near total destruction of U.S. amphibious forces preparing to conduct an assault against Iran. As LtGen Van Riper put it “We probably got half their ships... the aircraft carrier. The biggest cruisers. There were six amphibious ships. We knocked out five of them.”¹⁴ Had the OPFOR assault occurred in a shooting war instead of an exercise, the U.S. Navy would have lost at least eight ships and nearly 20,000 sailors and Marines before they ever fired a shot. The defeat was so total the exercise director had to “reset” the game for the exercise to continue.¹⁵

One of the main criticisms of the exercise focused on the decision to reset and how that decision produced a predetermined outcome in the face of significant evidence that the networked, high-tech U.S. force lost.¹⁶ While true, it misses the larger point. Van Riper was successful because the U.S. Force was surprised. Tactical surprise resulted in the loss of the entire amphibious force and operational and strategic defeat. Had the U.S. forces recognized the potential threat posed by all those small boats, they could have avoided defeat. All necessary information was available. The fleet knew the boats were present. They knew the boats were armed and that Iran had anti-ship missiles. They knew the narrow Straits of Hormuz limited the Task Force’s ability to maneuver, and they were still taken by surprise. The outcome was not a technological failure; it was a failure of imagination – that is, a lack of mental agility - a failure of the “human in command.” Millennium Challenge 2002 was more than a clash between two Joint Forces. It was clash of command and control philosophies.¹⁷

¹⁴ Gladwell, *Blink: The Power of Thinking*, 110.

¹⁵ HFriedman, H “Wargame Raises Questions,” 5-6.

¹⁶ Ibid., 6.

¹⁷ Gladwell, *Blink: The Power of Thinking*, 108.

Van Riper set the tone early with his staff. “The first thing I told our staff is that we would be in command and out of control.” The OPFOR operated within Van Riper’s intent. Beyond that, Van Riper expected his subordinate commanders to use initiative – he did not allow his staff to interfere with his tactical commanders. During planning, Van Riper’s general guidance to his air forces was to hit the U.S. forces from different directions. According to Van Riper, “he never got specific guidance from me of how to do it. Just the intent.”¹⁸ This approach grew from Van Riper’s Viet Nam experience. In his second tour in Viet Nam, LtGen Van Riper did not respond immediately when he heard gunfire in his area of operations. The rationale was that if his subordinates needed help, they would call for it. The problem with making that call to demand information or a situation report from his subordinates was simply that they would “tell you anything to get you off their backs” and if you acted on the information they gave you, you were acting on inaccurate or incomplete information. Further, “you are diverting them. They are now looking upward instead of downward.” Simply by making the call you would prevent him from developing, then resolving, the situation.¹⁹ Van Riper’s formative experience in Viet Nam stayed with him, ultimately expressing itself in a “command by influence” approach to command and control.

Millennium Challenge 2002 demonstrates two key ideas central to this thesis and the requirement for the Joint Force to adopt mission command. Without doubt, the U.S. Forces commander believed his networked force had achieved information dominance and that because he had access to unprecedented amounts of information, he knew what his adversary would do. His decisions were predicated on decision support processes

¹⁸ Gladwell, *Blink: The Power of Thinking*, 118.

¹⁹ Ibid.

designed to leverage information. U.S. Forces acted in the belief that their highly detailed common operating picture conferred understanding of the environment. The result was a force unprepared to react to a low-tech adversary who did not act as expected. The opposing force under LtGen Van Riper operated under a significantly less restrictive command and control approach. LtGen Van Riper ensured his subordinate commanders understood his intent, and then delegated decision authority to the maximum extent possible, transforming his force into an edge organization. This approach clearly demonstrated the utility of power to the edge. Although not the lessons the Exercise was designed to teach, Millennium Challenge 2002 provided both a potent reminder of the danger inherent in over-reliance on information and decision systems and a graphic demonstrating of the power derived from pushing decision authority to the edge and the resulting agility and adaptability of the force employing edge principles.

CONCLUSION

I know that most men, including those at ease with problems of the greatest complexity, can seldom accept even the simplest and most obvious truth if it be such as would oblige them to admit the falsity of conclusions which they have delighted in explaining to colleagues, which they have proudly taught to others, and which they have woven, thread by thread, into the fabric of their lives.

-- Count Leo Tolstoy

The Joint Force must take active steps to encourage innovation and distributed decision making. As communications and information technologies continue to proliferate through the Joint Force, the control function assumes increasing prominence in command and control. The ability for strategic and operational commanders to observe actions at the tactical level produces significant pressure on higher commanders to direct action at the tactical level. That direction is rarely welcome, and often counterproductive. Mission command provides a bulwark against tactical interference by operational staffs.

The same technology that allows an operational commander to direct tactical activity can and should be used to disseminate commanders' intent. Further, the systems should be used to encourage lateral communication, coordination, and collaboration and not solely as a pipeline to send reports up and orders down. Direct liaison authority should be the default – it should not have to be granted specifically in orders. The most effective command and control arrangements are those that allow subordinate commanders the greatest amount of decision space possible consistent with commanders' intent. Mission command provides that command control arrangement.

Mission command meets the requirements levied on the Joint Force by the current and future global environment. Communication and information technology enable rapid

vertical and horizontal communications to support mission command. Mission command produces agile, adaptable forces to meet the challenges of the 21st century national security environment. For these reasons, it is imperative that joint doctrine adopt mission command.

The global operating environment is complex and the resulting threats to United States' National interests are "wicked problems." These ill-defined problems cannot be solved solely through planning. While planning is necessary to understand the environment and to secure resources, it is not sufficient to resolve the problems facing the Joint Force. Operational Design shows enormous potential for helping joint commanders arrive at a useful model of the operating environment and an understanding of the nature of wicked problems they are expected to resolve but does not provide a map to direct tactical action in support of operational objectives – nor should it. At its best, planning identifies a range of possibilities and provides the resources to address potentialities. As the environment changes in response to Joint Force actions, the Joint Force requires a method, expressed in doctrine, to ensure the agility necessary to recognize and adapt. Mission command provides a possible solution to the absolute requirement for an agile, adaptable Joint Force.

Current joint command and control doctrine retains sufficient foundation to support centralized command and control theories. Although existing and emerging communications and information technology increase the ability to centralize command and control functions, the Joint Force must resist the temptation to do so. In the absence of compelling strategic or operational reasons to retain decision authority at higher

command echelons,¹ decision making authority should be pushed as far forward as possible consistent with commander's intent. Pushing decision authority to the interface between elements of the Joint Force and the operational environment provides the best chance of responding immediately and appropriately to changes in the environment, producing agile response and maintaining tempo while allowing the operational commander to retain focus on operational requirements. Mission command is the mechanism to preserve freedom of action at the point of decision.

¹ Illustrative examples include retaining control over nuclear weapons release at the National strategic level, and assigning missions to individual aircraft through the ATO at the operational level. The incredible destructiveness and potential political consequences of nuclear strike should not be delegated. The relative scarcity of aircraft and the requirement to engage strategic and operational targets requires efficiencies in their employment.

BIBLIOGRAPHY

- Alberts, David S. and Richard E Hayes. *Power to the Edge: Command and Control in the Information Age*. Washington, DC: Department of Defense Command and Control Research Program, June 2003.
- Alberts, David S. and Richard E. Hayes. *Understanding Command and Control*. Washington, DC: Department of Defense Command and Control Research Program, 2006.
- Banachm Stefan J. "Educating by Design: Preparing Leaders for a Complex World." *Military Review* 89, No. 2 (March/April 2009): 96-104.
- Blaker, James. "Arthur K. Cebrowski: A Retrospective." *Naval War College Review* 59, no. 2 (Spring 2006): 129-145.
- Brady, Malcolm. "Improvisation Versus Rigid Command and Control at Stalingrad." *Journal of Management History* 17, no. 1 (2011): 27-49.
- Bremer, Jan. *The Burden of Trafalgar: Decisive Battle and Naval Strategic Expectations on the Eve of the First World War*. Newport Paper #6, Newport, RI: Naval War College, Oct 1993.
- Callo, Joseph. "Lasting Lessons of Trafalgar." *Naval History* 19, no. 5 (Oct 2005): 16-22.
- Collender, Matthew and Lieutenant Colonel Matthew Deller. "Scoping Complex Systems for the Joint Forces Commander." *Campaigning: Journal of the Joint and Combined Warfighting School* (Fall 2008): 37-81.
- Conklin, E. Jeffrey. *Dialogue Mapping: Building Shared Understanding of Wicked Problems*. Hoboken, NJ: Wiley, 2006.
- Czerwinski, Thomas. "Command and Control at the Crossroads." *Parameters*, Autumn 1996. Pp 121-132
- Department of the Air Force. *Air Force Doctrine Directive 2-8, Command and Control*, Washington, DC: Government Printing Office, June 2007.
- Department of the Army. *Field Manual 6-0, Operations*, Washington DC: Government Printing Office, August 2003.
- Department of the Navy. *Marine Corps Doctrinal Publication 6, Command and Control*, Washington, DC: Government Printing Office, October 1996.

Department of the Navy. *Navy Doctrinal Publication 6, Naval Command and Control*, Washington, DC: Government Printing Office, May 1995.

Denning, Peter J. "Hastily Formed Networks." *Communications of the ACM* 49, no. 4 (April 2006): 15-20.

Denning, Peter J. "Network Laws." *Communications of the ACM* 47, no. 11 (November 2004): 15-20.

Denning, Peter J. and Rick Hayes-Roth. "Decision Making in Very Large Networks." *Communications of the ACM* 49, no. 11 (November 2006) 19-23.

Department of Defense Command and Control Research Program. Mission Statement. "About the Program." Department of Defense. http://dodccrp.org/html4/about_main.html (accessed March 4, 2012).

Eriksson, Henrik, James M. Nyce, and Lieutenant Colonel Per-Arne Persson. "Command Control: A Biased Combination?" in *The Human in Command: Exploring the Modern Military Experience, Proceedings of a NATO RTO workshop held in Kingston, Jamaica 8-12 June 1998*, ed. Caroline McCann and Ross Pigeau, 201-216. New York: Kluwer Academic/Plenum Publishers.

Fleischer, Mark. "Foundations of Swarm Intelligence: From Principles to Practice." Center for Satellite and Hybrid Communication Networks. CSHCN TR 2003-05, 2003.

Friedman, Norman. "Wargame Raises Questions." *United States Naval Institute Proceedings*, 128. No. 10 (Oct 2002): 4-6.

Gladwell, Malcolm. *Blink: The Power of Thinking Without Thinking*. New York: Little, Brown and Co, 2005.

Hanley, Brian. "The Enduring Relevance of the Battle for Stalingrad." *Joint Forces Quarterly* Issue 43 (4th Qtr 2006): 92.

Irvine, Dallas D. "The French and Prussian Staff Systems Before 1870." *The Journal of the American Military History Foundation*. Vol. 2, No. 4, Winter 1938.

Jeffery, Major-General M.K. "Forward," in *The Human in Command: Exploring the Modern Military Experience, Proceedings of a NATO RTO workshop held in Kingston, Jamaica 8-12 June 1998*, ed. Caroline McCann and Ross Pigeau, v-vii. New York, Boston, Dordrecht, London, Moscow: Kluwer Academic/Plenum Publishers.

Joint Chiefs of Staff. *Doctrine for the Armed Forces of the United States*. Joint Publication 1. Washington, DC: Joint Chiefs of Staff, May 2007 (Incorporating Change 1, March 2009).

Joint Chiefs of Staff. *Department of Defense Dictionary of Military and Associated Terms*. Joint Publication 1-02. Washington, DC: Joint Chiefs of Staff, November 2010 (As Amended Through 15 January 2012).

Joint Chiefs of Staff. *Joint Operations*. Joint Publication 3-0. Washington, DC: Joint Chiefs of Staff, August 2011.

Joint Chiefs of Staff. *Joint Operation Planning*. Joint Publication 5-0, Washington, DC: Joint Chiefs of Staff, August 2011.

Joint Chiefs of Staff. *Joint Vision 2010*. Washington, DC: Joint Chiefs of Staff, 1995.

Joint Warfighting Center. *Design in Military Operations – A Primer for Joint Warfighters*. Joint Doctrine Series Pamphlet 10. Norfolk, VA: Joint Forces Command. 20 September 2010.

Keithly, David M. and Stephen P. Ferris. “Auftragstaktik, or Directive Control, in Joint and Combined Operations,” *Parameters* (Autumn 1999): 118-133.

Lewis, S.J. “The Battle of Stalingrad.” In *Block by Block: The Challenges of Urban Operations*, ed. by William G. Robertson, 29-62. Fort Leavenworth: U.S. Army Command and General Staff College Press, 2003.

Marshall, S.L.A. *Men Against Fire: The Problem of Command in Future War*. Gloucester, MA: Peter Smith, 1978.

Middlebrooks, Sam E. “The Compass Paradigm for the Systematic Evaluation of U.S. Army Command And Control Systems Using Neural Network And Discrete Event Computer Simulation.”

National Intelligence Council. *Global Trends 2025: A Transformed World*. Government Printing Office (Washington DC, November 2008).

Nelson's Signal at Trafalgar. *The Washington Post* (1877-1922); Dec 2, 1883. Originally published in *The London Herald*.

Nelson, Lord Horatio. *August to October 1805*. Vol. 7 of *The Dispatches and Letters of Vice Admiral Lord Viscount Nelson; With Notes by Sir Nicholas Harold Nicolas, G.C.M.G.* London: Henry Colburn, 1846.

- Nelson, John T. "Auftragstaktik: A Case for Decentralized Battle." *Parameters* (September 1987): 21-34.
- Nixon, Richard M. *Six Crises*. Garden City, NY: Doubleday and Co, Inc., 1962.
- O'Neil, Colonel John E. "Commander's Comments." Speech, 135th Expeditionary Sustainment Command Headquarters, Kandahar Air Base, Afghanistan, March 2010.
- Pearson, Gordon. *The Rise and Fall of Management: A Brief History of Practice, Theory and Context*. Farnham, Surrey: Gower Publishing, Ltd., 2009.
- Rittel, Horace W.J. and Melvin M. Webber. "Dilemmas in a General Theory of Planning." *Policy Sciences* 4 (1973): 155-169.
- Rumsfeld, Donald H. *Transformational Planning Guidance*. Policy Memo. Arlington, VA: Office of the Secretary of Defense. Apr 2003.
- Rycroft, Robert. *Self-Organizing Innovation Networks: Implications for Globalization*. Occasional Paper Series. Washington, DC: George Washington University, 2003.
- Scherrer, Joseph H. *Risks and Vulnerabilities of Network-Centric Forces: Insights from the Science of Complexity*. Newport, RI: Naval War College. February 2003.
- Stephenson, Lieutenant Colonel (Retired) Scott. "The Revolution in Military Affairs: 12 Observations on an Out-of-Fashion Idea." *Military Review* (May-June 2010): 38-46.
- Surowiecki, James. *The Wisdom of Crowds*. New York: Doubleday, 2004.
- United States Marine Corps. *Command and Control*. Marine Corps Concept Paper (MCCP) 6. Headquarters, USMC (Washington, DC, 12 December 1995).
- Van Creveld, Martin. *Command in War*. Cambridge, Massachusetts: Harvard University Press, 1985.
- von Clausewitz, Carl. *On War*. Translated and edited by Michael Howard and Peter Paret. New York, Toronto: Alfred A. Knopf, 1993.
- Wallace, Lieutenant General William S. "Network-Enabled Battle Command." *Military Review* (May/Jun 2005): 2-3.
- Welsh, William. "Nelson at Trafalgar: He Did His Duty." *Military History* 22, no 7. (Oct 2005): 38-44.

Widder, Major General Werner. “Auftragstaktik and Inner Führung: Trademarks of German Leadership.” *Military Review* (September-October 2002): 3-9.

VITA

LTC David Gillum was commissioned in 1990 through the Reserve Officer Training Corps after four years of service as an enlisted infantryman. Following the officer basic course, he served in a variety of command and staff assignments both CONUS and abroad with multiple combat tours in both Iraq and Afghanistan. LTC Gillum is a graduate of the University of Oklahoma with a Bachelor of Arts degree in Political Science.